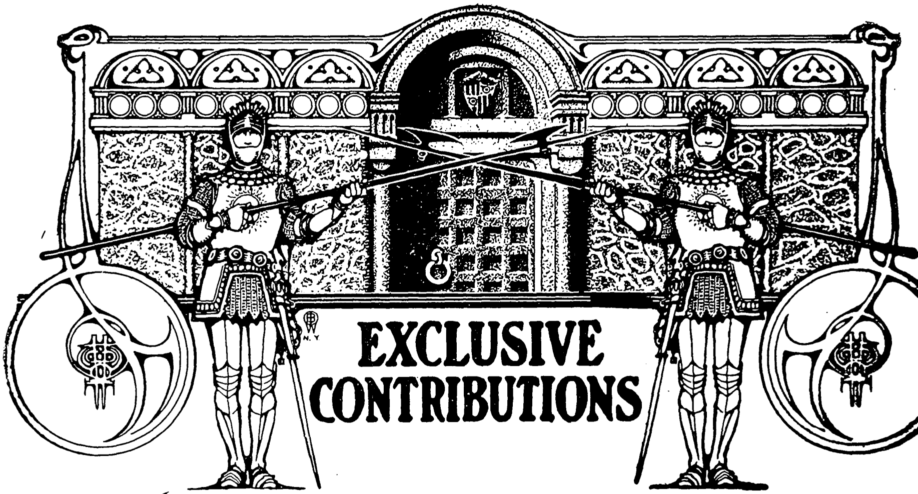

Dental Radiography.*

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X-Ray Machines.

It was stated in Chapter I that an electric current is necessary to produce X-Rays, but nothing was said concerning the strength of the current required. It takes a current very high in voltage, varying from 30,000 to 300,000 or more volts, and low in amperage, the amperage being measured in milliamperes.

The ordinary commercial circuit for lighting purposes is almost invariably either D.C., 110 volts, or A.C., 60-cycle, 100 to 125 volts. The amperage varies according to the amount of electro-motive power needed, ranging from 4 or 5 to over 100 amperes. The commercial current, *as supplied,* is therefore useless. However, it will operate a machine which will give the desired current.

X-Ray Machines.

X-Ray machines are of two classes: Those that generate their own electricity without any external electric supply, and those that depend on a commercial current or storage batteries to excite them. There is but one of the first class, namely, the static machine (Fig. 12), and of the second class there are three—the Ruhmkorff coil (Fig. 13),

the high frequency coil (Fig. 14), and the "interrupterless" coil (Fig. 15). All of the latter class are literally induction coils, just as the transformer, described in Chapter I, is an induction coil, but when the term induction coil is used we may assume that it is the Ruhmkorff coil that is referred to. We shall follow the precedent and call the Ruhmkorff coil the induction coil, though it is no more an induction coil than the high frequency or "interrupterless" coils.

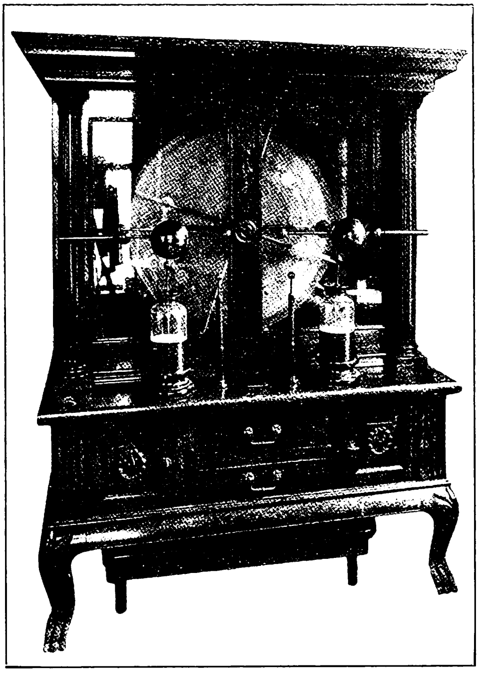


Fig. 12. A static machine

The static machine is so much inferior to the induction coil for picture work, and so large and difficult to operate, compared with any coil, that the only reason for using it would be the lack of a commercial current with which to operate a coil. Even in such an event—the lack of a commercial current—I would advise the use of an induction coil operated by storage batteries (Fig. 16) in preference to the static machine.

Induction Coil.

The induction coil is indisputably the most popular apparatus for giving the electric current necessary for X-Ray picture work. It is a step-up transformer to this extent, namely, its primary current is

of comparatively low voltage and high amperage, while the secondary is very high in voltage and low in amperage. It differs from the transformer in mechanical construction, and also in that the primary current must be an interrupted current, and the secondary, induced current is

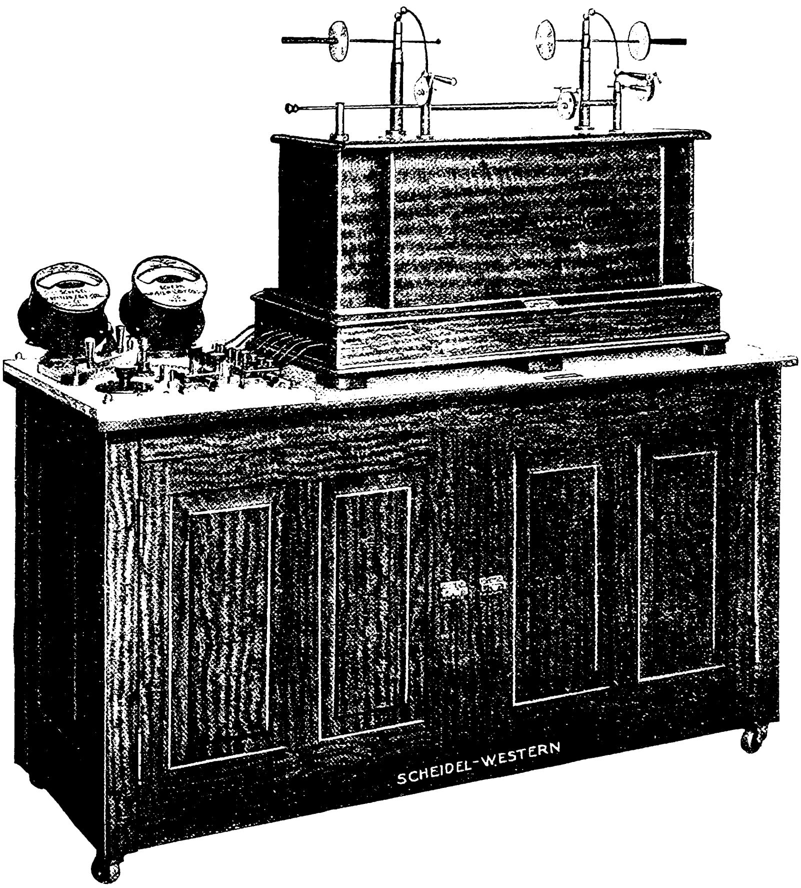


Fig. 13. Induction or Ruhmkorff coil

practically a uni-directional one. It will be recalled that the primary and secondary currents of the transformer are both alternating.

Installation. Let us trace a current of electricity from the mains through an induction coil and auxiliary appliance leading to it. (Fig. 17.)

Wiring from the mains to the coil should always be done by a com-

petent electrician. A wire of a given size will carry only a certain amperage without heating. If this amperage be exceeded greatly the wire may become hot enough to set fire to surrounding building material of a combustible nature. There are, therefore, laws governing the size of wires to be used to carry different amperages. Coils are rated by their manufacturers to consume a certain number of amperes, and wiring should be done according to this rating. The amount of amperage neces-

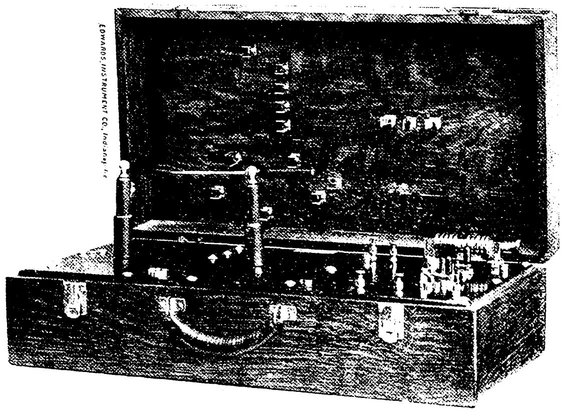


Fig. 14. High frequency coil

sary to operate a coil varies directly according to the size of the coil—the larger the coil the more amperes it takes. Assuming the coil to be of a medium large size, the lead wires used to connect it to the mains should be capable of carrying at least 30 amperes without heating. By "lead wires" I mean the wires leading to the machine—not lead (the metal) wires. The wires are copper.

Fuses.

Somewhere near where the wires enter the building, and also at the coil itself, will be found fuses. (Fig. 18.) A fuse is a wire, an alloy of lead, of a given size, and fusing point capable of carrying only a limited amperage without melting. Thus, if more than 30 amperes be sent through a 30-ampere fuse, the wire is heated to its fusing point, it melts, the circuit is broken, and the flow of electricity is stopped. A fuse is a sort of safety valve. About 30 ampere fuses should be used for a medium large induction coil. This information, however, will always be given by the manufacturers of the coil.

Switches.

Somewhere near where the wires enter the building, and also at the coil, are placed switches. An electric switch (Fig. 19) is an appliance for throwing the electric current into, and out, of an extended circuit.

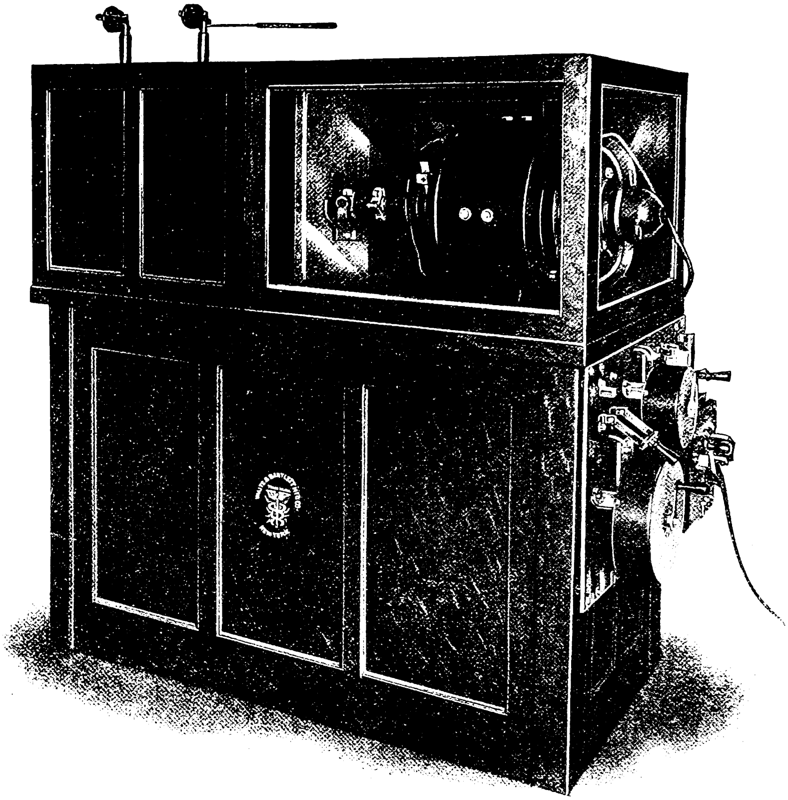


Fig. 15. Interrupterless coil

Assuming that the current at our disposal is D.C., it must first be passed through an interrupter.

Interrupters. An interrupter is an electric apparatus by means of which a constant current is converted into an interrupted one. Interrupters are of three kinds: (1) The electrolytic, Fig. 20; (2) the mercury turbine, Fig. 21, and (3) the mechanical or vibrator, Fig. 22.

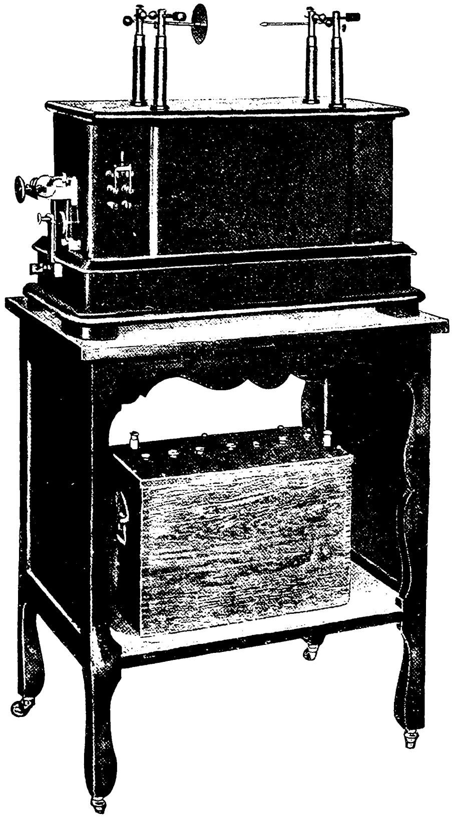


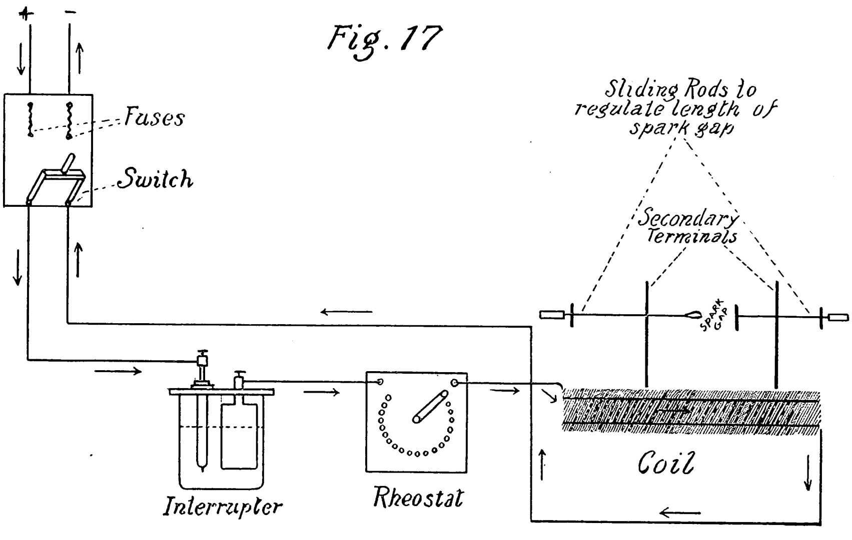
Fig. 16. Induction coil for use with storage cells

For picture work, in connection with the induction coil, the electrolytic, or, as it is sometimes called in honor of the inventor, the Wehnelt interrupter, is quite the best. With it the constant current may be interrupted at the rate of from 60 to 30,000 interruptions per minute. The mercury turbine gives from 200 to 3,600 interruptions per minute, and the vibrator from 250 to 1,000 interruptions a minute.

The electrolytic interrupter consists of a glass jar containing a solution of sulphuric acid in water, the electrolyte, in which is immersed a platinum point electrode, "A" (Fig. 20), and a lead electrode, "B." The platinum is covered with a porcelain sheath, C, except for its point, which

projects into the electrolyte. Little or much of the point may be exposed in the acid by the regulating arm, D.

We have two wires now leading from the mains to our apparatus. Of these one is the positive wire which brings the electric current, and the other is the negative or return wire. The positive wire must be attached to the binding post of the platinum electrode, marked +. (Fig.



20.) But how can we tell which is the positive wire? Cut some of the insulation off the ends of the wires, immerse them in a glass of water, and bubbles will be given off from the negative wire. When making this test, care should be taken not to touch one wire to the other, so making a short circuit. The term (short circuit) almost explains itself. The desired circuit in this instance is from the positive wire, through the water, which is highly resistive to the flow of electricity, into the negative wire and back to the mains. Suppose that the wires come in contact (that portion of the wires from which the insulation has been removed), the current no longer passes through the water, but takes the shorter path of less resistance, passing directly from positive to negative wire. All the amperage formerly used and choked back by the resistive water flows through the wires, heating them rapidly.

The course of the electric current, through the electrolytic interrupter, is from platinum through the acid electrolyte, and on through the lead electrode. As the current flows through the acid solution, a chemical change occurs and a gas is formed. This gas accumulates in

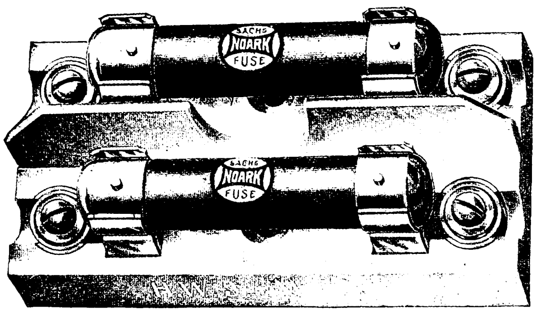


Fig. 18. Patent fuses or cutouts

Fig. 19. Knife switch

the form of a bubble around the exposed platinum point, and momentarily stops the flow of the current. Then the bubble bursts and the current is re-established only to be stopped again in the manner just described, and so on. The more platinum exposed in the solution the slower the interruptions and the more amperage will pass through the interrupter. In order that the amperage may be increased without producing a corresponding decrease in the number of interruptions per minute, interrupters are made with several platinum points. (Fig. 23.) Thus with a multipoint interrupter, when more amperage is desired, more points are thrown

into the circuit by means of small switches for the purpose. A two-point interrupter will draw enough amperage, and give sufficiently rapid interruptions, for dental radiographic work.

The current is sometimes stopped altogether by the interrupter. This may be due to the accumulation of a large bubble of gas on the platinum point, which will not burst. By moving the point—or points if the inter-

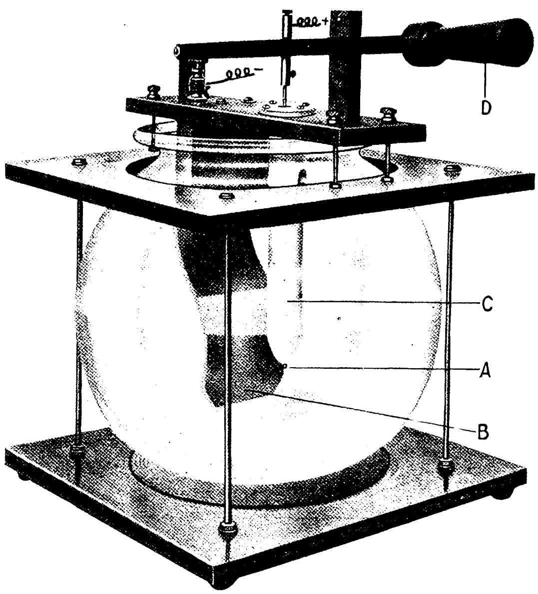


Fig. 20. Non-water cooled one-point electrolytic interrupter

rupter is multipointed—up and down several times by means of lever D, Fig. 20, the bubble will be broken and the current re-established.

On a D.C., 110-volt circuit the electrolyte should be 15 to 20 per cent. acid; on a D.C., 220-volt circuit, from 5 to 8 per cent. is strong enough. The jar should be one-half or three-quarters full. As the solution stands, some of the water evaporates, so raising the per cent. of acid in the electrolyte. As this occurs, more water should be added. The strength of the solution can be easily and accurately determined by means of a special hydrometer. (Fig. 24.) As the water evaporates, and the solution gets stronger, its specific gravity raises. The hydrometer is sensitive to this change of specific gravity, and shows by a special marking the exact per cent. of the solution.

As the current passes through the interrupter, heat is produced. Hence the glass jar is placed in a metal-lined box, and the box filled with water. (Fig. 23.) Even with this means for cooling, when used continuously for fifteen minutes or longer, the electrolyte becomes so heated that the interrupter no longer works properly. In dental picture work, though, the time of operation is a matter of seconds. It, therefore, will be understood that no trouble ever occurs due to heating of the electrolyte.

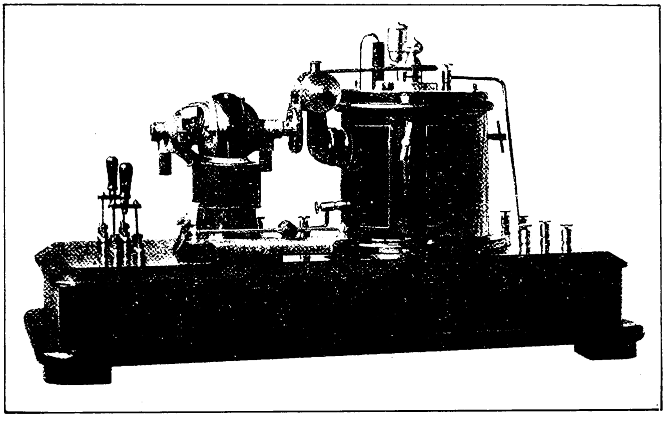


Fig. 21. Mercury turbine interrupter

When the X-Rays are used for their therapeutic value, long exposures are made; so long that undue heating of the electrolytic interrupter would be sure to occur. Hence, for this work the mercury turbine interrupter (Fig. 21) is best. In principle the mercury turbine is a mechanical interrupter, depending on no chemical change for its action, being operated by means of an electric motor. We shall not consider it further, for it should not be used for picture work, except in the absence of an electrolytic interrupter.

The mechanical interrupter, or vibrator (Fig. 22), is used only on the smallest coils. The principle on which it operates is the one involved in the construction of electric bells: Fig. 25 illustrates the principle. A is a movable arm with fulcrum at B. When the current travels, the path marked with arrows, the electro-magnet, C, draws the movable arm, A,

over to it, breaking the circuit at D. When the circuit is broken the electro-magnet loses its magnetism and the spring, E, draws the movable arm back, re-establishing the circuit. The rapidity of interruptions may be regulated by altering the strength of the spring. A popular form of vibrator is the ribbon vibrator illustrated in Fig. 26.

Rectifier. In tracing the current directly from the supply wire into the interrupter, we have assumed, as stated, that we are receiving our supply from a D.C. circuit.

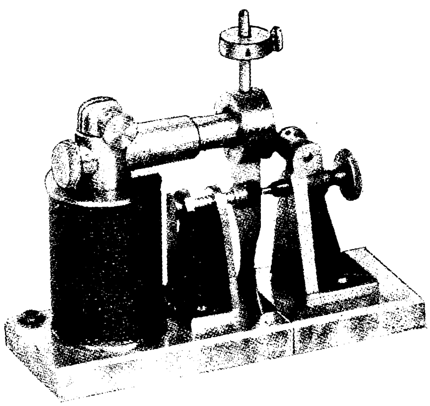


Fig. 22. Vibrator or mechanical interrupter

Suppose, however, that the only current at our disposal is A.C., as is often the case. It is necessary to send the alternating current through a rectifier (Fig. 27) before allowing it to enter the interrupter.

A rectifier is an electrical apparatus by means of which an alternating current is converted into a unidirectional, pulsating current, and consists of a glass jar containing an electrolyte, a solution of ammonium phosphate usually, in which is immersed a steel electrode and an aluminum electrode. The jar, the electrolyte, and the two electrodes constitute one cell. Fig. 27 shows a one-cell rectifier.

With the direct current, we are able to test and determine which of the two lead wires is positive. This is impossible with the alternating current, because polarity changes at each alternation. Either of the lead wires may therefore be attached to the steel electrode, and a wire connected from the aluminum electrode to the platinum of the interrupter.

As long as the aluminum remains the negative electrode of the rectifier, the current flows from steel to aluminum and on, but when the current reverses and starts to flow from aluminum to steel, a chemical change occurs in the aluminum, making it a non-conductor and choking off the flow. Thus a current of 60-cycle frequency, after passing through a one-

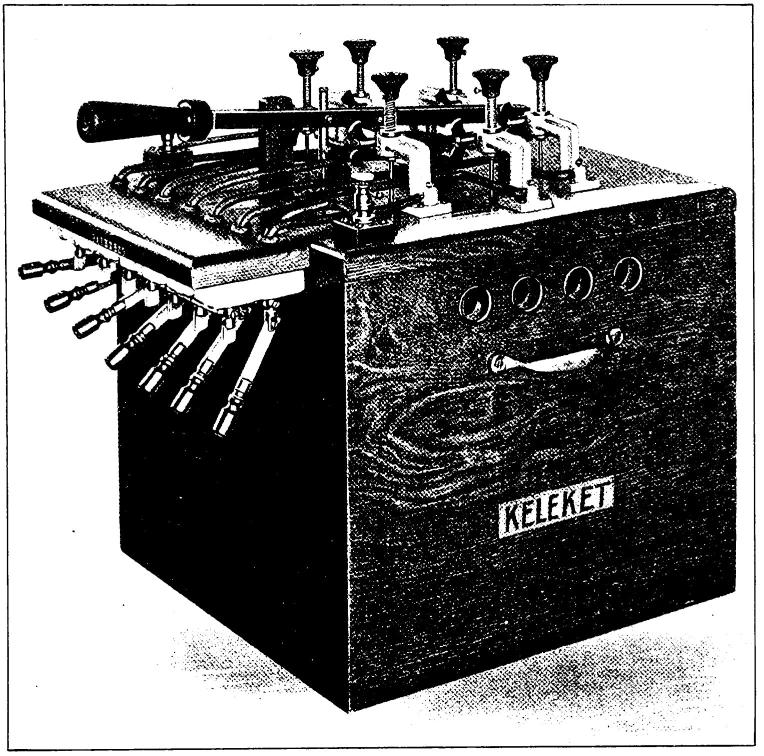


Fig. 23. Seven-point electrolytic interrupter, water-cooled

cell rectifier, becomes practically (there is a slight inverse current) a uni-directional current with 30 interruptions per second. If, after passing through the rectifier, as just described, the current is an interrupted one, the questions arise: Why send it through an interrupter? Why not directly on to the coil? Because the interruptions are not sharp and complete enough. The current is pulsating rather than interrupted.

By connecting three or four rectifier cells in a certain way (Fig. 28), we are able to obtain practically a uni-directional, constant current.

If the supply current is 60-cycle, as is usually the case, the electrolyte in the interrupter remains the same as for a D.C., 110-volt circuit, namely,

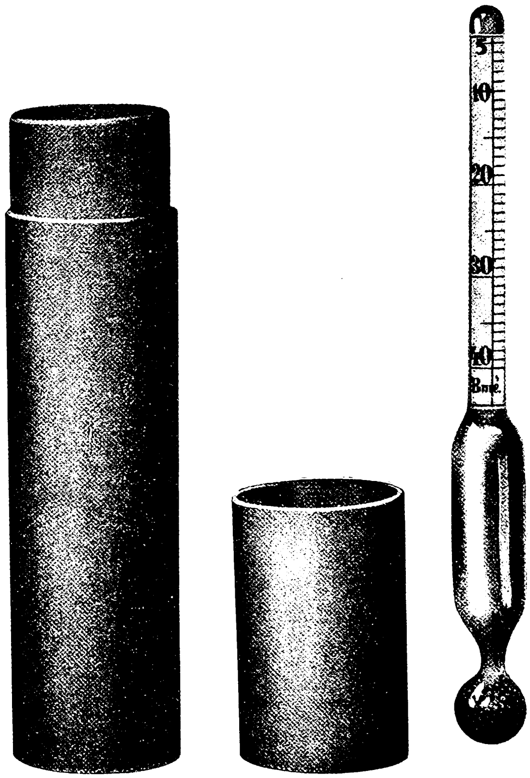


Fig. 24. Acid hydrometer

about 20 per cent., but if the A.C. supply is 133-cycle, the solution should be stronger—about 30 per cent.

From the interrupter the current passes into the rheostat, as per Fig. 17.

Rheostat.

A rheostat (Fig. 29) is an apparatus by the use of which we are enabled to regulate the quantity of electricity entering an electric machine. The rheostat does not have much effect on voltage.

Fig. 30 illustrates the rheostat. A represents coils of wire, often German silver, offering great resistance to the flow of electricity. When the arm, B, is on button, 1, the current must pass through all the resistive wire on its way to the electric machine, induction coil, motor, or what not. This resistive wire chokes back amperage. On button, 2, there is less resistance; on button, 3, still less, until on the last button the current passes directly into the machine. The rheostat illustrated acts

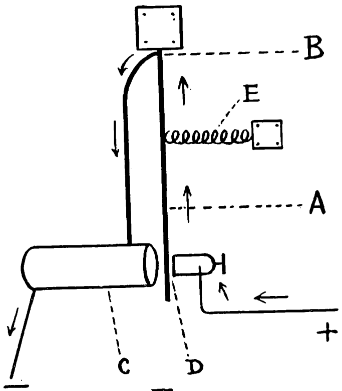


Fig 25

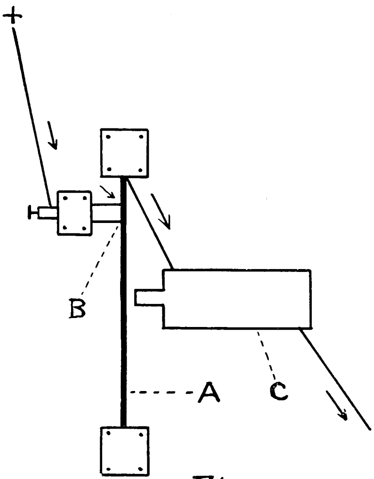


Fig 26

Fig. 25. A, movable arm with fulcrum at B. C, electro-magnet. D, break. E, spring of circuit

Fig. 26. A, piece of ribbon steel. B, point where circuit is broken. C, electro-magnet

also as a switch, completely breaking the current when the arm, B, is on button, 0.

From the rheostat the current passes into the coil proper, follows the wire of the primary winding, and passes back through the negative lead wire to the mains.

A different method of wiring to that shown in Fig. 17 is illustrated in Fig. 31. At first glance it seems that the primary current is not interrupted, the interrupter being on the negative wire with the current passing through it after passing through the coil. But since the current cannot enter the coil any faster than it leaves, the manner of its exit will govern its entrance, and hence the current of the primary is interrupted just the same, whether the interrupter be placed on the positive or negative lead wire.

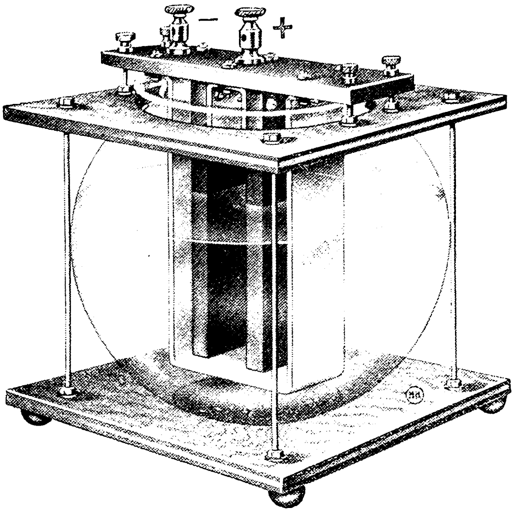


Fig. 27. One-cell rectifier

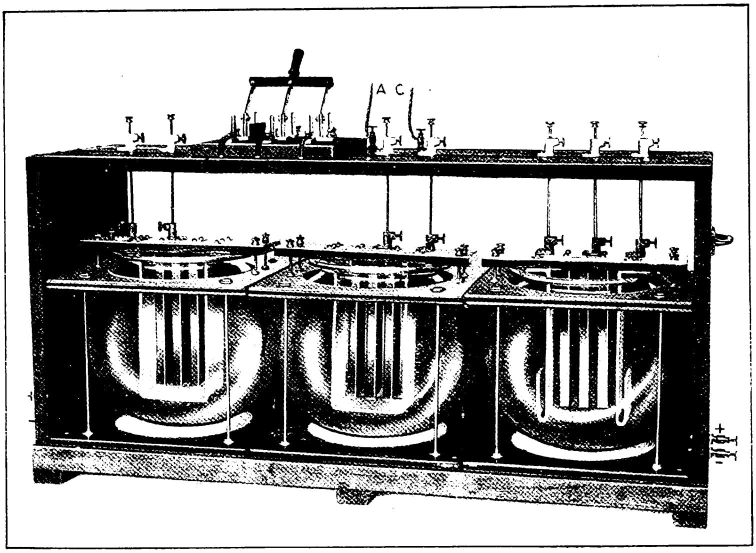


Fig. 28. Three-cell rectifier

Coil. The coil consists of a soft iron, cylindrical core, around which is wrapped insulated copper wire, the primary winding. (Fig. 32.) (The necessity for good insulation will be appreciated if we stop to consider what would happen if the core were wound with uninsulated wire. If this were done the current would not follow the windings of the wire at all, but would choose the shorter path of less resistance, passing along the iron core,

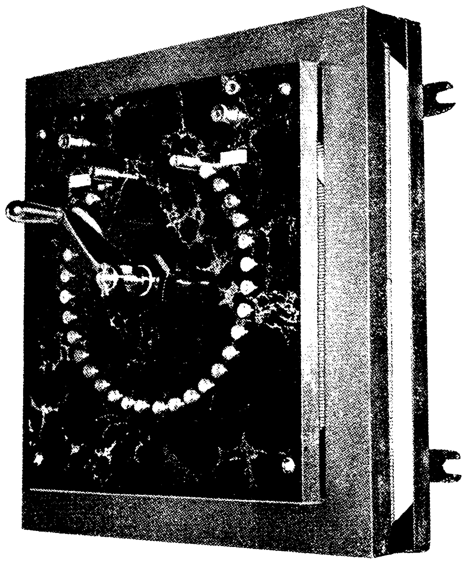


Fig. 29. Twenty-nine button rheostat

making a short circuit.) Over the primary winding is placed a heavy insulation of mica or vulcanite, and around this is wound more insulated wire, the secondary winding. (Figs. 32 and 33.)

There is positively no electric connection between the primary and secondary windings. The primary current passes through the primary winding and into the negative lead wire. But in its passage it has induced or created a secondary current in the secondary winding.

Coils are rated and designated according to the maximum number of inches of atmosphere the secondary current can be made to jump. As the current jumps from one terminal to the other of the secondary winding, a spark occurs, due to the resistance of the atmosphere to the flow of the current. When we speak of a coil as, say a 12-inch coil, we

mean that the spark gap of that coil is twelve inches long; that its secondary current can be made to jump twelve inches of atmosphere. The larger the coil the longer the spark gap. From 6-inch to as high as 40-inch coils are manufactured. From 8-inch to about 18-inch coils are the sizes generally used.

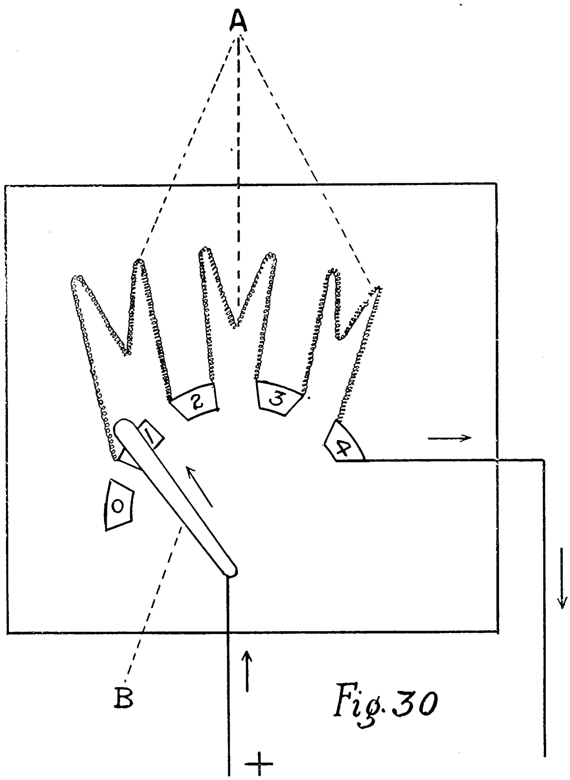


Fig. 30

The wire of the primary winding is from 12- to 8-gauge; of the secondary from 34- to 29-gauge. The length of the windings varies according to the size of the coil, of course. The wire in the primary of a 12-inch coil is about 100 feet long, in the secondary about 28 miles long. The wire in the primary of an 18-inch coil is about 140 feet, and in the secondary 38 miles long.

At each "make" and "break" of the circuit of the primary current, a current is induced in the secondary. The secondary current induced at the break of the primary flows in the same direction as the current in

the primary, while the current induced at the make, flows in the opposite direction. Thus the secondary is an alternating current; but the current of the make is so much weaker than the current of the break that, for practical purpose, the secondary may be considered a uni-directional, pulsating current. The current of the make is what is known as the inverse current, and it is the effort of all coil manufacturers to make a coil giving as little inverse current as possible.

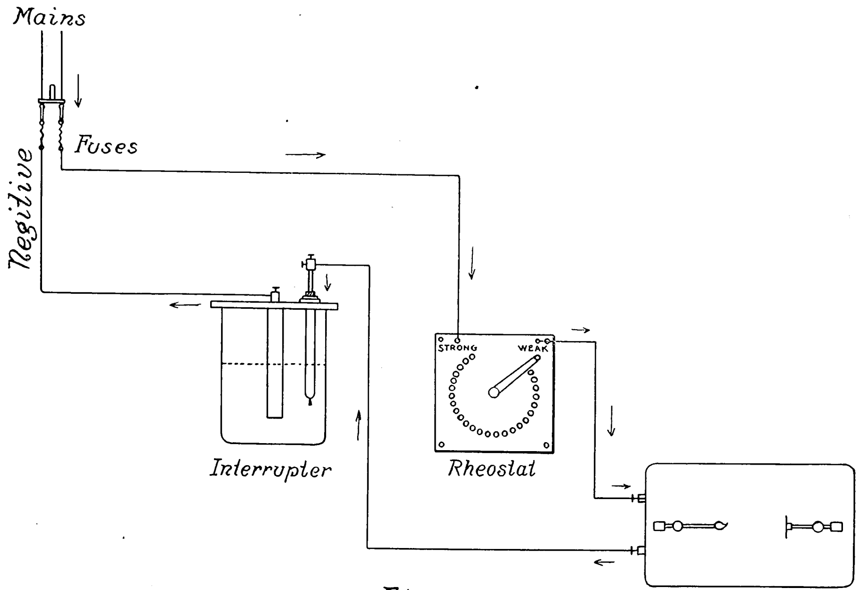


Fig 31

The voltage of the secondary current cannot be determined accurately. Authorities differ very greatly in their estimate of the number of volts required to jump one inch of atmosphere, giving the figure as low as 10,000, and as high as 60,000. What voltage is required to jump each succeeding inch after the first, is also a question shrouded in very great uncertainty.

Estimating each inch of atmosphere at 10,000 volts, which perhaps is getting as near the truth as possible at the present time, the voltage furnished by any size coil can easily be determined. Figuring on this basis, an 8-inch coil in full operation supplies a current with a potential of 80,000 volts; a 20-inch coil, 200,000 volts.

The amperage, or, to be more exact, the milliamperage of the secondary current of an induction coil varies according to the resistance

through which the current is forced. Thus, allowing the rheostat to remain on the same button, the milliamperage is increased or decreased accordingly as the spark gap (Fig. 17) is shortened or lengthened. With

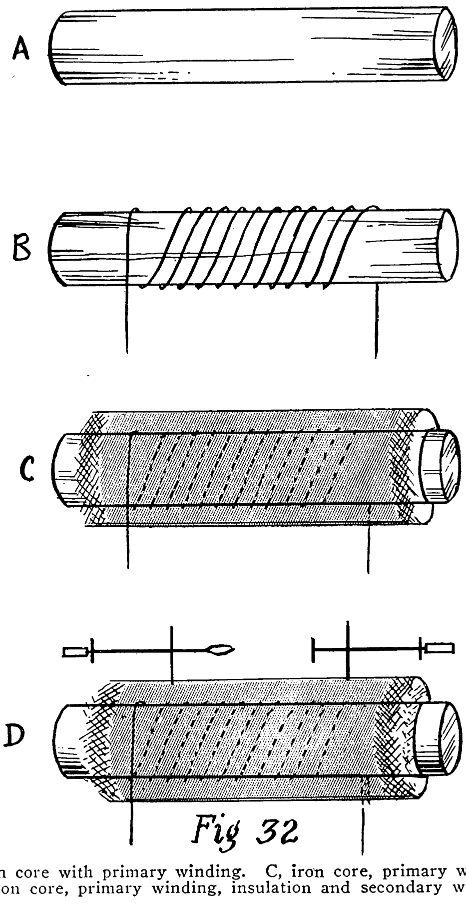


Fig 32

A, iron core. B, iron core with primary winding. C, iron core, primary winding and insulation. D, iron core, primary winding, insulation and secondary winding

the spark gap at its maximum length, the milliamperage is least. As the sliding rods are pushed closer to one another, so lessening the length of the spark gap, milliamperage increases. Different coils are capable of forcing different milliamperages through their maximum length of spark gap. Thus one 10-inch coil may be able to force twenty milliamperes

through ten inches of atmosphere, while another could send only two milliamperes through such a resistance. All coils give a high milliamperage on a short spark gap, the amount running into hundreds of milliamperes. Instead of the sliding rods, some coils have an arrangement, as per Fig. 34, for regulating the length of spark gap.

The milliamperage strength can be estimated roughly by the appearance of the spark. A thin, blue spark indicates low amperage. A

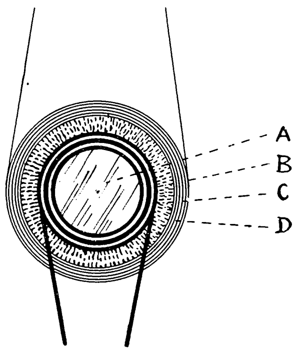


Fig. 33

Cross-section diagram of induction coil. A, iron core. B, primary winding. C, insulation. D, secondary winding

fat, fuzzy spark, the caterpillar spark, indicates high milliamperage. To do rapid dental radiographic work a coil should give at least six inches of the fat, fuzzy spark.

Ampere meters and milliampere meters are used on the primary and secondary currents, respectively, to measure their volume. (Fig. 13.) While these meters may be considered luxuries rather than necessities, they are certainly very useful luxuries.

Coils Dangerous.

How dangerous are the currents of an induction coil? is a question often asked. Both primary and secondary currents of an induction coil are dangerous. The larger the coil the greater the danger. If one should come in contact with a terminal of the coil, he would receive a severe, painful shock. It would be much more severe and painful if the victim happened to be standing on a conductor, for then the current would pass entirely through the body into the conductor. If one should

come in contact with both terminals of a large coil, so that the entire current would pass through the body, the accident might result fatally.

High Frequency Coil.

Now let us consider the high frequency coil. (Figs. 14 and 35.) In mechanical construction the high frequency coil may be considered a kind of double coil with the secondary of the first coil acting as the primary of the second coil. The primary current of the first coil should be A.C.

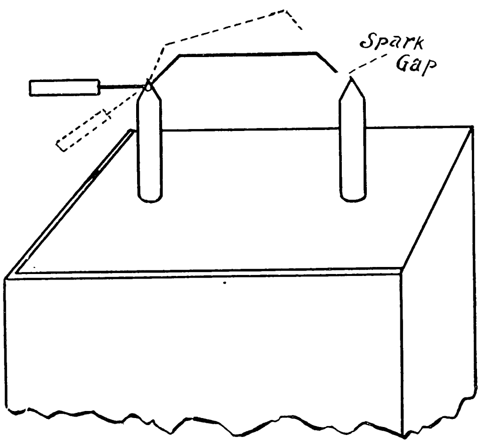


Fig 34

From the supply wire the current passes through the primary winding of a step-up transformer (first coil) at the usual commercial 100 to 125 volts, 60-cycle. (Fig. 35.) An alternating current of the same frequency as the primary, but higher in voltage and lower in amperage, is generated in the secondary of the transformer, and passes into the condenser, which acts as a reservoir. As the current leaves the condenser and jumps the regulating spark gap, it is oscillating at a frequency of from 10,000 to more than a million. It passes through the primary winding of the Tesla coil, inducing a secondary current of the same high frequency. This Tesla coil is the same as an induction coil (Figs. 32 and 33), except that some inert substance, instead of soft iron, is used for the core.

The secondary current of the second coil is the one supplied by the machine, the one to be used to generate X-Rays. Like the current of the Ruhmkorff, or induction, coil, this current is high in voltage and low in

amperage. The current of the induction coil is, however, practically a uni-directional one, while the current supplied by the high frequency coil is alternating at the inconceivably high frequency of tens of thousands or millions. Hence the term "high frequency," which is applied to the current and the coil producing it.

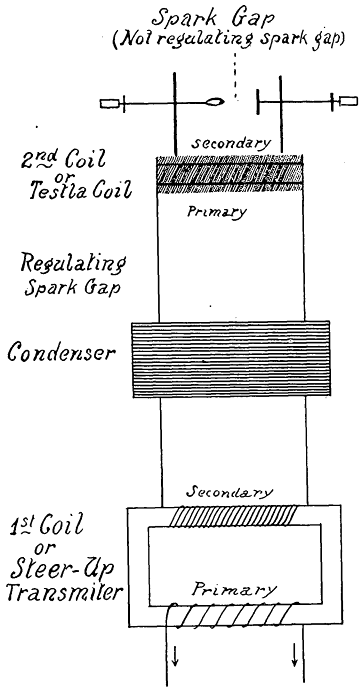


Fig. 35

The frequency is governed by the size of the condenser; the smaller the condenser the higher the frequency. Thus most "high frequency and X-Ray machines" are equipped with a switch, by means of which all, or a part, of the condenser may be used. When using the coil for X-Ray work, this switch should be turned to "low frequency," so that all of the condenser is used. When using the coil for "high frequency" treatments —using the current as a therapeutic agent—the switch should be on "high frequency," so that only a part of the condenser is used.

By means of the regulating spark gap, we can control to an extent the secondary current of the second coil—the current supplied by the machine for use. Widening the gap increases voltage at the expense of the amperage; narrowing the gap increases amperage at the expense of the voltage. The wattage remains the same. For X-Ray work the gap should be as short as possible, without reducing the voltage to a point where the current will not pass through the X-Ray tube.

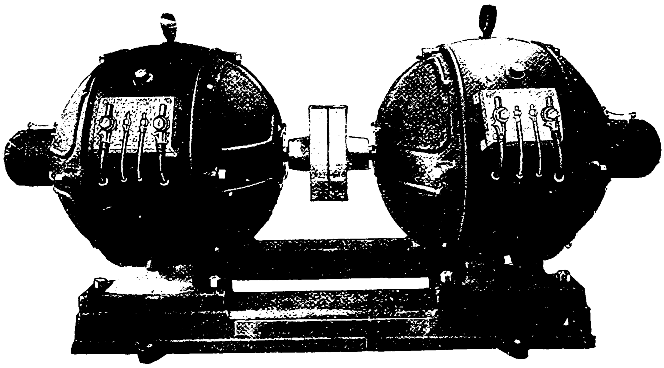


Fig. 36. Rotary converter, or motor-dynamo

The ideal current for exciting an X-Ray tube (in other words, producing X-Rays) is an absolutely uni-directional one. Compared with that of the high frequency coil the current of the induction coil more clearly approaches this ideal. Because of this, the writer advises the use of the induction coil in preference to the high frequency coil, unless a portable machine is desired. We thus eliminate large high frequency coils from further consideration.

The small, portable, suit-case, high-frequency coils called "X-Ray and high frequency coils," may be used where the lack of space makes the installment of a larger machine impossible, when a transportable coil is wanted, and when the purchaser wants to make the minimum cash investment.

As stated, the primary, or supply, current of a coil, built on the high-frequency plan illustrated, should be A.C. When attaching the portable coil (Fig. 14) on an A.C. circuit, therefore, all that needs to be done is to screw the attachment into a lamp socket.

Rotary Converter.

When the supply current is D.C., a rotary converter should be used. A rotary converter (Fig. 36) consists of an electric motor set in motion by the supply current, which motor in turn revolves the armature of an A.C. dynamo, which generates the electricity that is sent

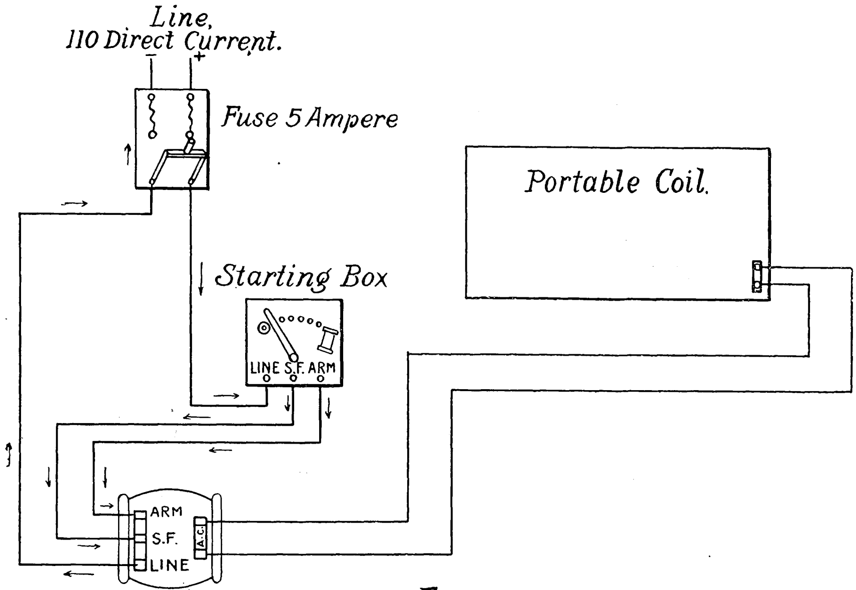


Fig. 37

into the coil. Instead of having the D.C. motor and the A.C. generator as separate machines connected by a common shaft, so that movement of the armature of one machine revolves the armature of the other, the rotary converter can be made so as to be enclosed in one casing. (Fig. 15.)

Tracing the current, as per Fig. 37, coming through the fuse and switch, the current passes through the positive wire to the starting box or rheostat. It leaves the starting box through two wires, passing through one to the field of the motor marked S.F., through the other to the armature of the motor, marked ARM, and out of the motor through the negative lead wire. A new circuit is formed from the generator side of the converter marked A.C., passing through the coil.

It may be well to state just here that an electric motor is, in construction, practically the same as a dynamo or generator. In fact, taking

a given machine, it may be used as either a dynamo or a motor. If its armature is revolved by some power, it will generate electricity, and it is then a dynamo; if a current of electricity is sent into its field and armature, the armature revolves, and it is then an electric motor. Motors are made to be operated by both D.C. and A.C. circuits; that is, we have D.C. motors which can be run only by a direct current, and A.C. motors which can be excited only by an alternating current.

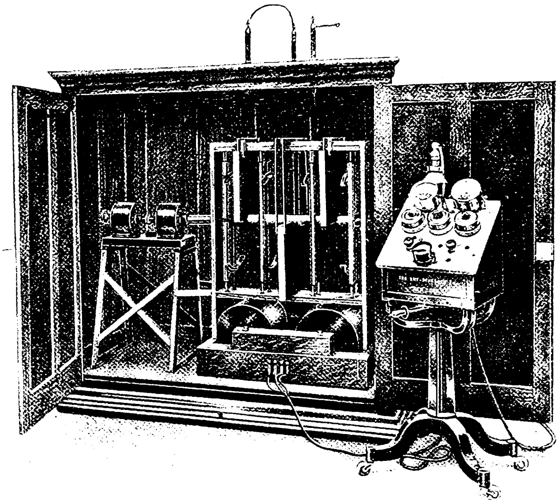


Fig. 38. Interrupterless coil, showing switch and rheostat, rotary converter, transformer and rectifying switch

Instead of a rotary converter, some machines are equipped with a mechanical vibrator (Fig. 22), which interrupts the current as it enters the coil. This is not so efficacious as the converter. Machines with the mechanical interrupter are advertised to operate on either A.C. or D.C. circuits.

The length of the spark gaps of portable machines vary from four to ten inches. They are seldom able to give a fat, fuzzy spark longer than half the length of the spark gap. The full-length spark is almost always thin and blue.

Danger of Currents.

As a general proposition the alternating is the most dangerous of electric currents. Mysterious and surprising as it is, however, high-frequency currents, such as high-frequency coils produce, are much less

dangerous than the current of an induction coil. If one should touch a terminal of a high frequency coil a spark would jump to the hand just as it came within sparking distance of the terminal. This spark might make a blister, but if the experimenter had been standing on a non-conductor, no further discomfort would be felt. Indeed, one may take a small steel bar and, standing on a non-conductor, touch a terminal of the coil and so take into the body enough current to cause great injury, if it were of the nature of the induction coil, without receiving any sensation at all. If he should stand on a conductor, however, the shock would be painful. If he should grasp both terminals, so that the entire current passed through the body, the result would be severe pain and probably injury. The larger the coil the more dangerous the current.

The primary current of the portable high-frequency coils is not as dangerous as the primary current of the stationary induction coils, because they draw only from three to ten amperes, while the induction coils seldom draw less than twenty and as high as sixty amperes.

Interrupterless Coil.

The "interrupterless" coil, or transformer, as it is often called (Fig. 15), is the newest and perhaps the most powerful X-Ray machine made. On the market these coils are known by such trade names as "The Snook Roentgen Apparatus," "The Peerless Roentgen Apparatus," "The Solace Interrupterless."

The interrupterless coil consists of a rotary converter, a step-up transformer, and a rectifier switch. (Fig. 38.) The step-up transformer may be of the closed magnetic circuit core type (Fig. 10), or the open core type (Fig. 32). These machines are of two kinds: Those built to be operated on a D.C. circuit, and those designed for the A.C. circuit.

Let us consider the former first: The converter is set in motion by the commercial direct current. It generates an alternating current, which is sent through the primary of the transformer. The induced current in the secondary is of the proper voltage and amperage for X-Ray work, but it is alternating. It should be direct. It is made so by means of the rectifying switch, and is then an ideal current for X-Ray work. The rectifying switch is a revolving mechanical device similar to a commutator in principle.

The A.C. machine is similar to the D.C. machine, the principal difference being the addition of an A.C. motor. An alternating current motor transmits mechanical power to the "rotary converter," which, in this case, becomes simply an A.C. generator, not, strictly speaking, a rotary converter, though it is usually so-called.

Since the supply current is alternating, and it is an alternating current that must be sent into the primary of the coil, one may logically ask,

Why not send the commercial current directly into the primary, instead of operating an A.C. motor, which, in turn, revolves the armature of an A.C. generator, which produces the current which is sent into the coil? The answer is that the rectifier switch must work in synchronism with the generator, which supplies the current to the coil. In other words, the rectifier switch must be on the same shaft, and revolve in unison with the generator in order to rectify the alternating current induced in the secondary winding of the coil.

The interrupterless coils are rated according to the amount of "energy" they create, not according to their spark gap length. The spark gap is usually ten or twelve inches long. The machines are rated to have a capacity of so many kilowatts. Take a "4 kilowatt" machine, for example. Its primary current, we will say, is 100 volts, 40 amperes (4,000 watts), the secondary current something like 100,000 volts, 40 milliamperes (4,000 watts). This system of rating is being adopted by manufacturers of induction coils also.

CORRECTION.

The writer wishes to apologize, to both his readers and ITEMS OF INTEREST, for the following mistakes made in the first installment of this work on Dental Radiography, in the February issue:

On page 83, third paragraph. "The pulsating current is one in which the electricity flows through the conductor in one direction while in motion, but which is completely arrested in its flow at frequent recurrent intervals." The word "pulsating" should be changed to *interrupted.*

The definition for the pulsating current, which was omitted, is: "The pulsating current is one in which the electricity flows through the conductor in one direction, but at variable pressure."

On page 84, second paragraph, a sentence ends, "in one second of time." This phrase should be cut out.

Technical Training of the Dental Student.

By Dr W. W. Evans, Washington, D. C.

In the first place, no student should be admitted into a dental college who does not show good manipulative ability, or who has not passed a creditable course in manual art training, such as is being introduced into many of our public schools—the J. Liberty Todd System.

The freshman should have but one lecture per week on prosthetic dentistry, and one lecture per week on anatomy of the teeth from either Black's or Broomell's works. This would harmonize with the laboratory work in tooth carving, and these should be profusely illustrated, the drawings conforming entirely and definitely with the manual training in the laboratory of that week. There should be a perfect harmony between professor and demonstrator. The technical course for this student should be of the simplest character, commencing with the training of the hand and eye to the use of the file, engraver, jeweler's saw and other tools. Say, for instance, they start on a cylindrical bar of steel or brass of about three-quarters of an inch in diameter and four inches long. File this to a perfect square, then to an octagon, then to a triangle, the demonstrator taking note on each form. The digital training in this simple exercise is immense. It should take at least a week or ten days for the earnest student, and three or four weeks for the careless one.

Next take up some light form in brass, requiring file and jeweler's saw, sawing out forms and delicately fitting other pieces of metal into the opening. This softens the hand to sensitive adjustment, and trains the eye to proportion and precision.

Following this the carving of single teeth, copying natural ones; first in clay, then in vegetable ivory. In this work the teacher should assist the pupil in the selection of a uniform set of natural teeth to work from; (temporarily balanced) eight or ten students could work from this same set at the same time. This would probably occupy a month or more, and should, under proper direction from the professor and demonstrator, impress the student with the natural form of the human teeth. A half set, right or left, both upper and lower, in clay; and not less than six in ivory, three above and three below, central, bicuspid and molar. This will bring them close up to the Christmas holidays, and a breathing spell.

Following along the same lines, they should assemble the teeth. This gives them indirectly an idea of the all-important subject—occlu-

sion. The most desirable point in this procedure is, for the teacher to furnish a plaster model of a full set of teeth from a plaster impression, or a commercial set made from celluloid or rubber, and the student to copy this in moulder's clay, beginning with the upper set alone, to get his hand in; finally working an upper and lower set together and endeavoring to occlude them with perfect cusps to the teeth, the same as the working models. The object of working in clay is, that if the student fails to model his forms correctly, he can add to or take from without having to do his work all over, with loss of more valuable material. This will occupy another month, possibly two, of the freshman's time, but is economically spent, as it gives him the stepping-stone to the most important fundamental principle of the dental profession in either branch.

Technic of Taking Impressions.

The next step would be to have these students take impressions in modelling compound. To do this intelligently, the demonstrator should demonstrate on an infirmary patient, paid patient, or one of the boys, showing kind of tray to suit the case, consistency of material, how to stand by the patient; in fact, the whole process, explaining each step as he proceeds, closing the lesson with the pouring of impression and making of the cast. Then allow each student to practice on either a paid patient or on one another, but never on a dummy. After the students have practiced this work sufficiently to understand it and pass creditably, the demonstrator should go through the same process in an edentulous upper jaw with a plaster impression, explaining everything, especially how to avoid getting an excess of plaster in the cup. Here we come upon obstacle number one, for it is not so easy to get edentulous mouths to practice on. However, fifty cents to an outside poor patient, or the promise to make a set of teeth without charge, helps to bridge over this chasm. From this, single porcelain teeth can be set up and a rubber plate made. Each step, however, should be done by the demonstrator and carefully explained before the student attempts to duplicate. The more intelligent students could go on with partial cases, but let quality stand ahead of quantity. It is this grinding that fits the student to be a dentist. Give the freshmen from two to four hours daily in the laboratory, and have it understood before they enter, that this class will be treated the same as in any public school or college; that they cannot be promoted to the junior class until they have passed the practical examination of the demonstrator, who is the real teacher in this class. Here is where we may weed out the undesirables and meet obstacle number two, and a big one. This is a progressive age, and dental schools must modernize as other educational

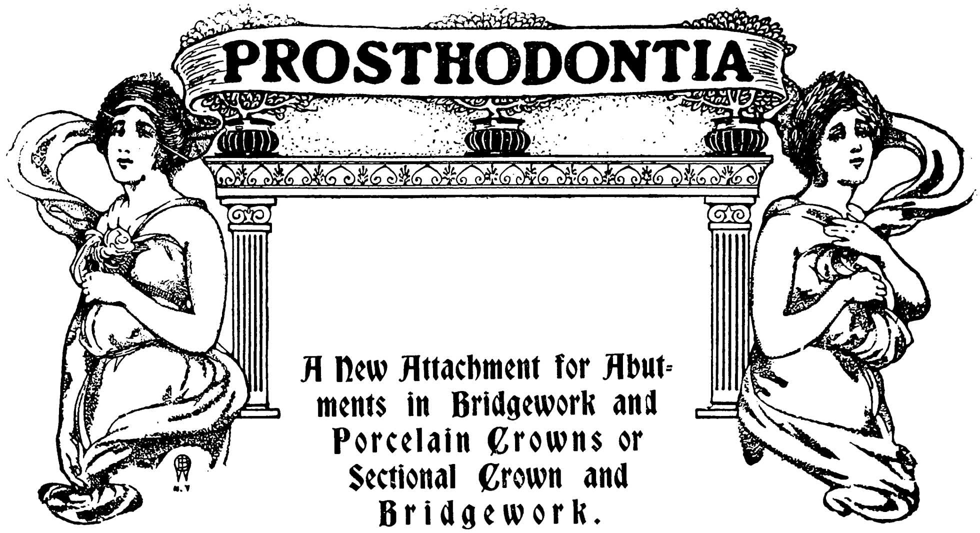
institutions are doing all over the world. Manual art labor, or digital exercises, have become a necessity to the mental development. They must employ the very best practical talent they can find for their demonstrators, and pay them sufficient to attract them.

The second, or junior year, would be a matter of gradual promotion in technic—say two hours daily, divided between infirmary and laboratory, commencing at the point left off by the freshmen, but working from infirmary to laboratory, taking impressions from the patients, the instructor giving them only the simple cases to start on, gradually taking up the more complex work. From vulcanite work in various forms, take up plate work, leading finally to the more intricate art studies, the professor of prosthodontia following along the lines of the practical work in the laboratory, so as to keep in perfect touch with the demonstrator and student.

In the senior year, the seeds that have been sown and nurtured in the two previous years should be fully developed plants ready to bloom. Continuous gum, bridgework, and orthodontia should be gone over, and the beauties of Nature, of inanimate things should be engrafted into the brains of the less appreciative creation man, whose greatest ambition is to possess coin at the least mental and physical exertion possible.

These suggestions are not mere idle fancy. They are mature thoughts after careful investigation of the methods of teaching in many of the colleges and attending meetings of the Institute of Dental Pedagogics. As it appears on the surface, the schools are run more upon a commercial basis, for dollars and cents, than institutions teaching manual dexterity, which dentistry is. The men who are the most respected by the world are the men who do things. The whole system is a jumble. The professors teach theoretically from text-books, which seem to be chaotic in character; the demonstrators, to a very large degree, are ignorant themselves of the requirements. What can we expect?

If I were running a dental college, I would teach the students how to do things with their digits, and they should not get out until they had learned. I would make my diploma worth something.



PROSTHODONTIA

A New Attachment for Abutments in Bridgework and Porcelain Crowns or Sectional Crown and Bridgework.

By GEORGE E. STALLMAN, Dental Surgeon, United States Army.

In the recent method of drawing or forcing molten metal into a mold, known as the casting process, still in its infancy, many new departures from the old system are undoubtedly being daily revealed to every dentist experimenting along these lines. That this method is an improvement on the old, and the means whereby much stronger, more artistic and better work can be done, there is no question. It requires, however, just as much skill and attention to detail as any other branch of dentistry, and he who thinks this an easy road to ideal results will surely fall by the wayside.

In the constant observation and study of crown and bridgework and the adaptation of all kinds of porcelain crowns to the roots of teeth, for over twelve years, it is rare indeed to see a perfect piece of work from a hygienic point of view; or absolutely perfect contact. The purpose of this paper is to give to the profession a method for the more perfect adaptation of porcelain crowns, such as any of those on the market where the pin is baked in the porcelain, without subjecting the porcelain to the flame; also procuring a perfect joint and at the same time adding to the strength of the pin to resist any subsequent stress. Also for abutments in crown and bridgework. There being two attachments, or sections, the one may be permanently cemented, the other, namely, the crown itself, may be set with gutta percha, for the subsequent easy removal in case of root irritation, treatment for the alleviation of the same being made through a tube in the cemented attachment. In an article in the *Cosmos* for June, 1909, Vol.

LI., No. 6, a suggestion is made for the manufacture of a hollow pin for crowns, with the above object in view. By the simple technique about to be described, this object is attained. By the use of the various detached crowns, such as the Davis, S. S. White, or Justi, good artistic results may be had by casting, but there is yet to be invented a detached porcelain crown, where absolute reliance can be placed upon the porcelain cemented to the protruding pin, and when cemented permanently in the root it cannot be removed, especially when the root is irritated or sore.

The Attachment In Bridgework.

My purpose here is merely to describe a small bridge for the front of the mouth with but one abutment, the same being a pin crown. To those who intelligently grasp its merits it will be obvious that this attachment can be utilized for any of the teeth used as an abutment. The method for making the attachment for the abutment for this bridge is probably a departure from anything usually done in this line of work. It consists simply of fitting over the pin a casing or tube of thin copper or platinum, 34 B & S gauge. Some might prefer a platinum tube, but I have found copper to answer all practical purposes, provided the gold is not cast too hot. Also, it is believed that the salts of copper exercise an inhibitory action upon certain forms of bacteria, and its presence in a previously putrescent root canal is therefore, in my mind, beneficial.

For my own use, I have had manufactured 12 inches of thin copper tubing, which is made seamless. This tubing fits accurately over a 17-gauge round iridio-platinum wire. I have also a box of carbon points, the same size as the wire. The use of these carbon points will be described. An instrument which any dentist can make is used for punching holes in the tube; an old excavator, the point of which is bent at right angles, answers the purpose admirably.

The tubing, wire, carbon points and instrument, comprise the necessary articles for carrying out the technic of making the attachment. We will now take, for instance, a decayed central incisor, the lateral missing. The pulp having been extirpated, and the end of the root filled, the root is ground to the gum line labially and to within 1/32 of an inch of the gum line lingually.

The tubing covering the wire is sawed off the necessary length for the post. The post with the tubing would now be the size of a 14-gauge wire, which is strong enough for all practical purposes. The canal is reamed out to receive the post and tube. The tube is laid aside temporarily, and a disk of 30-gauge pure gold is fitted to the outline of the root, swedged or burnished to the end, and a hole punched in the center to receive the post *without the tube.* This disk is soldered to the post, and the disk reinforced with 22 K solder.

The root is now shortened labially under the gum line by means of a facer, and ground lingually to the gum line only. The tube fitting over the post is now taken and two holes punched in one end with the instrument described. The holes are punched from within outward, leaving flared outer edges, as shown in Fig. 1.

These holes are important, and serve three purposes: First, wax melted around the tube is held firmly by the flared outer edges. Second, an instrument inserted in one of the holes while the tube is in the root canal enables you to easily withdraw the same without distorting the wax form. Third, they aid in firmly uniting the gold to the tube.

FIG. 1.

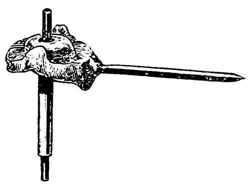


FIG. 2.

We are now ready to make the attachment which is to be reproduced in gold by the casting process.

The platinum post and root side of the disk are oiled slightly, the tube slipped over the post and wax melted around the tube, where the holes were punched, and built up sufficient for an impression of the root end. It is then returned to the root, using the disk as a tray, and pressed firmly to place. Chill with ice water, and remove pin and disk only, which usually come away clear, leaving the tube with the wax gasket attached thereto in the root.

This is removed by inserting the instrument in the hole in the tube, and withdrawing. Place the wax and tube over post, trim around the periphery of the disk and return again to the root. If everything is right, remove again and assemble the parts again. Now insert the sprue wire in the wax at its lingual aspect, next to the disk. Then remove the disk and post and lay aside.

Before investing in the casting ring, a carbon point an eighth of an inch longer than the tube is placed in the same. This *carbon point precludes the possibility* of any of the *molten gold entering the tube.* (Fig. 2.)

Cast as you would any ordinary inlay, except that the investment should not be too hot, the object being only to unite the inlay to the end of the copper tube. This can be done with the investment cold by those using a pressure casting machine, such as the Taggart. Of course, if a

platinum tube is used, the investment can be brought to a red heat. We have now the wax gasket reproduced in gold, and securely attached to the end of the copper tube.

This constitutes my attachment. It is now slipped over the post and disk and returned to the root. The gold gasket will fit the end of the root and the disk accurately. An impression and bite is then taken, and before pouring the impression, the tube and gold gasket are removed, and one or two holes punched anywhere in the tube. The holes will serve the purpose of holding the tube in the plaster cast, while the post and disk can be easily removed. The attachment is returned to the impression and the same poured. The resulting model will show the parts as in the mouth, except that the post and disk only can be removed. A porcelain facing of suitable shade and size is then backed with 32-gauge pure gold; also a facing for the incisor dummy. After the facings are backed, the pins are bent at right angles, attached with Parr's fluxed wax to the disk and model and removed from the model as a whole, the sprue wire attached and the piece cast with 22 K gold.

Or those who object to casting direct against the porcelain facings may use the old method of soldering these parts. It will be noticed that before casting against these facings they were backed with pure gold. If this is properly done—the facing bevelled and no overhanging edges left—and the case cast direct from the flame, the heat being underneath to the second of casting—there will not even be microscopical checks in the porcelain. To those, however, who are in doubt, any other way is advised. You have the model with the attachment always as a guide, so if failure is met with in your first attempt you can make as many more as you desire without the necessity of seeing the patient. Finish the bridge, and return the same to the model. If everything is correct, remove the attachment from the model, and slip it over the post as before. We have now two parts, the bridge itself, and the attachment, consisting of the tube and gold inlay, the two fitting accurately together. The copper tube, while on the pin, is now roughened or barbed for retention in the root canal, and if the canal is large, several more holes can be punched in the tube for retention. Or, when the bridge, with the attachment, is set in the mouth, and before the cement has hardened, the bridge is removed, leaving the attachment in the root. Place the instrument in the tube and punch more holes in the same, thus practically locking the attachment in the root canal.

It will be seen that the root end is now covered by the gasket, and the copper tube attached thereto, lining the root-canal and affording easy access to the end of the root. The fit of the bridge to the attachment is so perfect that no cement or gutta-percha is necessary. However, before

setting the bridge, the two parts can be heated and firmly united with gutta-percha, in which case the bridge could only be removed by heating the same in the mouth. For a bridge removable by the patient, a split pin is used made of spring wire or the pin of a Twentieth Century bicuspid crown, which is split and of good shape for root-canals.

The Attachment for a Double Rooted Bicuspid.

In case the abutment is to be a bicuspid with two root-canals, the same method of procedure is carried out. The post and tube are fitted into the lingual canal the same as in the case of the central incisor. After the post is soldered to the disk it is returned to the root, and an im-

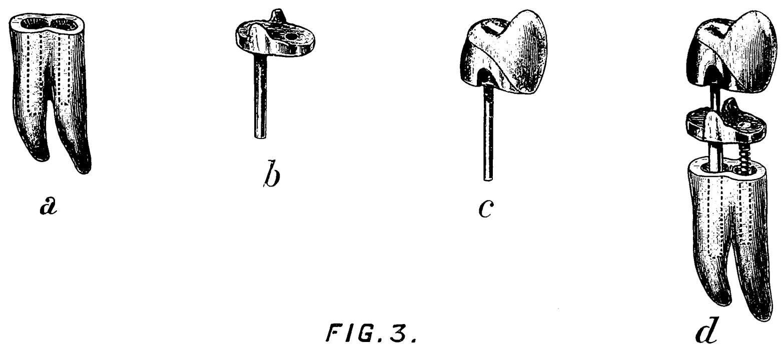


FIG. 3.

pression and bite taken. A veneer facing of the correct size and shade is selected at this time. After pouring the impression the resulting model will have the disk and pin with the tube imbedded in the model. Remove disk and pin and set another pin of same size in the tube, the end protruding from the tube about 1/16 of an inch. This end is roughened and grooved, and the facing selected attached to the end of the pin in correct alignment with the teeth. More wax is then added to restore contour and end of root. It is then removed, carved and polished, after which the sprue is attached and cast. But you can leave the original disk and pin in the tube, and make this bicuspid as best pleases you.

Fig. 3c shows a porcelain bicuspid with a round pin baked at its lingual third as advocated at the conclusion of this paper.

Fig. 3b shows the attachment with hole through gasket leading into the buccal canal. This description being, however, for an abutment, which is to carry a dummy, the same must be either of solid gold or the facing backed with gold in order to have a soldering surface. After the tooth is cast the tube is slipped over the pin, the root-end having been first shortened as before described, and an impression taken of the root-end, this time using the crown as a tray for carrying the wax. When

chilled the crown is removed, leaving wax gasket and tube in the root. A hole is now made through the wax into the buccal canal, and a 17-gauge wire inserted therein and withdrawn. It is then removed, placed upon the crown, and the wax trimmed around the porcelain. Examined with a magnifying glass and found right, a short carbon point of the same size as the wire is inserted into the hole in the wax. Investment material is now built up around the tube, carbon point, and root side of the wax gasket. After this has set, we can handle it without fear of distortion. The crown is then removed and the sides grooved or notched as shown in Fig. 3c.

These grooves will prevent the pin from bending, but are really unnecessary in a double-rooted tooth. For a single-rooted tooth, however, these grooves are absolutely essential, as will be shown later. After the grooves are made, the crown is oiled, especially the grooves, and placed in the tube again. More wax is now carried into these grooves, and to the wax already there. The sprue is attached at a convenient point, the crown removed, a carbon point set in the tube and cast as before. We have now the attachment for the bicuspid crown, which fits the same accurately; also the root-end. The hole leading into the buccal canal may be tapped and threaded, and when the abutment is set in the root, the crown is removed and a gold or platinum screw set through the hole in the inlay into the canal. (Fig. 3d.) An abutment made in this way is impossible to loosen, as the two pins for the canals, or rather the screw and the pin, need not be parallel with one another. In case of root irritation, it is only necessary to remove the crown, and then the screw, to get access to both root-canals. This method can be used for any of the multi-rooted teeth. Also, where it is used for this kind of a root not to be used as an abutment, the tapping and threading of the hole in the inlay is not essential. The attachment may be used with or without a band.

Single Porcelain Crowns.

If this attachment is useful for abutments in crown and bridgework, it is certainly ideal for single porcelain crowns. It can be made for any crown on the market, but not as easily and conveniently as for a crown with a round pin baked in the porcelain, as shown in Fig. 6, and Fig. 5 shows the relative length of the copper tube used with this crown for making the attachment. Since the era of casting has made possible this method, the shape of the pin, such as in the Logan Crown,—and that the same should be of some high-fusing metal, such as iridio-platinum,—is entirely unnecessary, as I will endeavor to show.

I should like to have the manufacturers make crowns for the market, as shown in Fig. 6, and as advocated at the end of this paper. These

could be sold with one or two tubes, and say one-half dozen carbon points, at a small increase of cost.

Method of Procedure. We have the crown with the copper tube telescoping the pin. The tube is laid aside, and the root ground as before, to the gum line only labially, and to within 1/32 of an inch lingually. The root canal is reamed to accommodate the tube and pin, and the porcelain ground to fit the gingival aspect of the root. The lingual aspect of the porcelain should be beveled away slightly.

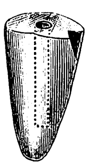


FIG. 4.

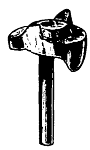


FIG. 5.

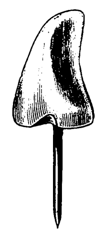


FIG. 6.

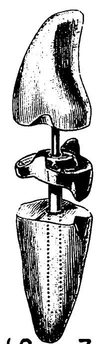


FIG. 7.

After the crown is fitted approximately, and the length and bite noted, the root is shortened as before, under the gum line, and lingually to this line. A groove or notch is now made in the root at the center of its lingual aspect, using a small stone or a No. 28 cone burr. (Fig. 4.)

The gold lug fitting into this notch will as effectually prevent fracture of the root as a band around the same. It aids in bringing the strain against the whole root, instead of against its anterior half. Also grooves are made in the porcelain crown on its sides. These prevent the pin from bending, and are very important. (Fig. 7.)

The crown tube and root preparation being now complete, the porcelain of the crown around the pin is oiled slightly, as in the case of the disk and pin, the wax melted around, and while soft, returned to the root, using the crown in this case as a tray, and pressing the same firmly to place, at the same time getting the correct alignment to the adjacent teeth. The same procedure is now gone through with as in the case of the bicuspid. After the attachment is cast the same is placed on the crown, dressed down and finally polished. The two sections, namely, the crown and the attachment, are now firmly united with gutta-percha. As

both sections can be heated, this is easily done, and a very close joint attained.

It is obvious that the crown pin and attachment are now strongly adherent, the pin also being strengthened by the addition of the gutta-percha and copper tube. The copper being soft, it can be easily roughened for retention in the canal, either by barbing with a knife, or before uniting the two parts, punching several holes in the tube, as before mentioned. The work is now cemented in the root, the result being perfect adaptation. The porcelain not having been subjected to the flame, we thus retain its translucency and original shade, and, in my mind, the result is probably the strongest and most artistic crown available. The object of using gutta-percha as the cementing material for uniting the two sections outside the mouth is for the purpose of easily removing the crown from the attachment in case of necessity after the attachment has been permanently cemented in the root. With lady patients, or public speakers, this is important, and it is a satisfaction to know that when a patient returns to the office complaining: "The beautiful porcelain tooth you recently put on for me is sore," you can at all times easily remove the crown, and thus give almost immediate relief. If the two parts are to be united outside the mouth, gutta-percha should, in all cases, be used as the cementing material.

In the army, many cases are presented where the front teeth are badly decayed, in some cases being broken off to the gum line. In reaming out such badly decayed roots, we have a large funnel-shaped canal. These roots, when treated and their apical ends filled, can easily be restored to usefulness again by this method: Wax is simply built up around the porcelain, and a tube slipped over the pin of the selected crown, carried to the root and pressed firmly to place. Remove the porcelain crown, leaving wax and tube in the funnel-shaped canal. Remove as before and return crown to the tube and wax gasket for trimming around the porcelain, and in case the wax impression has gone beyond the tube, the same must be trimmed away from the end. This is important, as it enables you to insert the carbon point entirely through the tube, and also to be able to remove the same more easily after the gold gasket has been cast around the copper tube. Try again in the root canal, and if everything is correct, attach the sprue wire to a selected place on the lingual aspect of the wax inlay, and cast as before. This will fit the crown and pin perfectly. The gold fitting into the root should then be grooved for retention, and this is more easily done in the wax than in the gold. The two parts are united with gutta-percha outside the mouth, as before described. The whole technic of making the attachment is simple, and consumes really very little time compared with

the old method of grinding a porcelain crown to fit the end of a root. But let me say, that probably in your first attempt to construct a crown with this attachment, success may not always be attained, as in this method, as well as in all new advances, certain technical details need first to be overcome before success in every case is reasonably certain.

I have inserted quite a number of these crowns; also abutments for bridges, using this attachment, and I will add that nothing in the art of dentistry has given me quite so much pleasure and a feeling of genuine satisfaction as in the restoration of lost teeth by this method. Also, I have tried to describe the attachment and method of procedure, merely from a mechanical or clinical viewpoint.

Scientific experimentation regarding the amount of stress or strain a post would withstand covered by an additional metal, between which is the cementing material, gutta-percha, I have not had the time to carry out. In addition to the notch made in the root, as described, I am inclined to believe that the gutta-percha between these two metals would have a tendency to act as a cushion, and prevent, to a certain extent, fracture of roots mounted with pivot teeth.

Mentioning again this wonderful casting process, and its application to the better adjustment of porcelain crowns, I desire to say that it is only a question of time when there must be a demand for a suitable artificial tooth to be utilized only by this process.

Therefore, the manufacturing concern that first gets in the field with the proper tooth will meet this demand.

We have no suitable porcelain crown for the multi-rooted teeth, the bicuspids and molars.

I would advocate a porcelain crown for these teeth with a round 17-gauge pin, baked in the porcelain. For bicuspids the pin to be set at its lingual third for adaptation into the lingual canal. For upper molars the same, and for the lower molars the pin to be set distally for adaptation into this canal.

If we had these porcelain crowns, they could be set with facility and ease by the use of the attachment described, and I believe they would be as strong and withstand the stress of mastication as effectively as any gold shell crown. Many people demand porcelain even in the posterior teeth.

The profession will also demand a change in the molds of porcelain crowns for the anterior teeth, the porcelain of which must be beveled at its gingival aspect in the form of an inclined plane, thus requiring only the adjusting of the gingivo-labial aspect of the porcelain to the root, the rest of the space to be taken up by the cast gold, the porcelain

only showing from the front. Then by the use of the attachment these crowns could be easily adapted to the roots of natural teeth.

Before closing, I will say that this attachment is patented, and an individual who invents a new thing is liable to be over enthusiastic regarding it. Therefore, it is not within my province perhaps to advocate too strongly the use of this attachment and the porcelain crowns suggested, except to say that they have been tried for some years and not found wanting. If the same, however, becomes popular the proper tooth will, and must, be supplied.

Again, it may be too technical for some, but to those who desire to develop something better along these lines—to do and to make better crowns and bridges—I submit with pleasure this attachment, and certainly feel, that as time goes by, its merit will in some instances, at least, be appreciated.

The Radiograph in Orthodontia.

A. H. Ketcham, D.D.S., Denver, Colorado.

Read before the American Society of Orthodontists, Denver, Colorado, July, 1910.

The Roentgen ray in combination with the photographic emulsion has proved of great value to the physician and surgeon, and as the conditions confronting the orthodontist in diagnosis are often quite as obscure, I believe that orthodontists generally would find it of great advantage to make more frequent use of the radiograph. Not only in determining whether an unerupted tooth is present, or to show its position when present, is the radiograph invaluable, but as we will see later, it may be possible to settle some questions about methods of treatment which have caused considerable discussion in the years gone by. Indeed, in many cases an accurate radiograph is just as necessary in diagnosis, and in the record of a case, as are accurate models.

I remember a case, a girl of fourteen years of age, who was referred by one orthodontist to another after the former had about half completed treatment, in which the left upper temporary cuspid was still in place. A radiograph had not been made, as the operator took it for granted that the permanent cuspid would erupt normally some time. The suspicions of the second orthodontist were aroused and he made a radiograph with the result shown in Fig. 1. You can see that the impaction of this cuspid would increase the difficulty of the treatment of this case to such an extent that the price of even a splendid X-ray outfit would not compensate the operator for the extra labor involved.

Unfortunately, orthodontists are not always situated so that they can secure the services of an operator who makes good dental radiographs, and, without fidelity to detail, a radiograph is practically worthless. Accuracy is a question of perfect technic and good judgment and is not too difficult for any careful operator to acquire. It is not surprising that orthodontists have been unable to find an operator competent to make accurate dental radiographs. The technic required to make these radiographs is quite different from the technic of those needed by physicians and surgeons, so how can we expect the physician, though he may be successful with radiographs in his line, to succeed, when he is ignorant of our needs and the technic required in this special part of X-ray work? Do you wonder then, that many orthodontists have nothing to show in their most interesting cases, but radiographs with blurred outlines of the teeth, with roots lengthened out of all proportion to normal, inaccurately showing the relation of an impacted tooth to its neighbors, and valueless for a study of the adjacent tissues? Fortunately, the technic now is so simplified that the physician, with a little instruction, may meet our needs, or the orthodontist may master the technic and make good radiographs of his cases as easily and as accurately as he makes good models.

Fig. 1

The Generator. Our first consideration in attempting radiographs is the generator. It is composed of an induction coil, an interrupter and a tube. It is best to have a coil giving a good reserve of power, say one with a 12-inch spark gap, which will give at least an 8-inch, or better still, a 10-inch white fuzzy flame between the terminal points. The electrolytic interrupter is best, because it permits of a shorter exposure than the mechanical interrupter. An extremely short exposure may be made with a multiple point interrupter. Green and Baur, of Hartford, Connecticut, make a very satisfactory self-regulating tube which they call the Clover Leaf.

I use the 6-inch size. It is well to use a milliampere meter which gives the amount of milliamperes used in the tube.

Stand to Support Tube.

A rigid stand should be used to support the tube so that it will not vibrate and destroy the sharpness of the radiograph. One end of the tube may be supported by an additional stand, which is made very

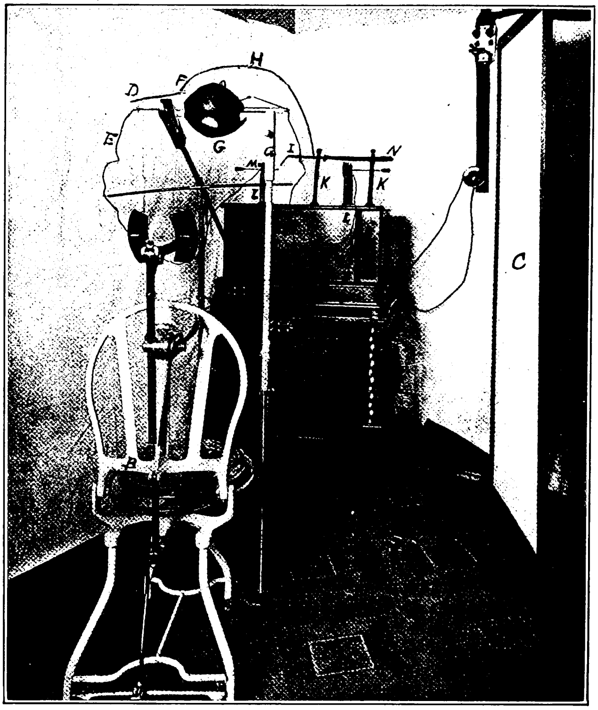


Fig. 2

easily by taking the wooden arm which supports the tube, from a regular stand, telescoping this in a piece of brass tubing which stands vertically on the floor, having a thumb screw inserted in same. The arm can then be adjusted to the tube by running up and down in the brass tube and locked by the thumb screw the proper height to reach the unsupported end of the X-ray tube (Fig. 2 A). This will make the support of the tube more rigid, which is very essential in obtaining fine detail on the film, especially when the heavy shield is placed around the tube, as well as lessening the danger of breakage to the tube.

The Chair.

The chair for the patient is important. A dental operating chair is good, but an adjustable chair, having a head rest, which is made for the use of rhinologists (Fig. 2, B), is less expensive, takes up less space and is more satisfactory than the dental chair, as it may be turned around easily so that either side of the patient's head may be presented to the X-ray tube.

Proper Vacuum for the Tube.

The X-ray outfit should be in a room which may be darkened easily so that the operator may observe the color of the tube.

It is impossible to give instructions by words only, so that a person may acquire a knowledge of the proper working vacuum for a tube, for such knowledge—like that of the proper density for an ordinary photographic negative—is only acquired by experience; let me say, however, that the usual way of determining the vacuum of the tube is by observing its color while in operation, the operator standing behind a lead screen which is placed behind the tube and looking through a bull's-eye of lead glass (Fig. 2, C).

The tube contains a platinum target called the anode, in the center of the sphere, with an aluminum disc at the end opposite, called the cathode. When the tube is filled with atmospheric air, as before it is exhausted, or when punctured from use or abuse, there is a violet stream or spark between the cathode and anode when the tube is connected with the coil—just the same as the discharge between the terminal points upon the coil when the tube is disconnected. When the tube is exhausted to a partial vacuum, just a light gas remaining, then connected to the coil in the proper manner, there is a well defined light in that half of the tube in front of the target or anode. The color of this light is perhaps best described as yellow when the tube is at the right degree of vacuum for good dental radiographs. When the vacuum of the tube is too low, a violet color will be seen behind the anode and around the cathode. If this appears while the tube is in use a puncture is liable to result unless the current be shut off at once. In such cases the teeth and bony tissue will give heavy black shadows with lack of detail. If the color of the tube is bordering on greenish, the vacuum is too high and the rays have such a high velocity that they pass through the bony tissues, of slight difference in density, like a bullet from a high power rifle, and do not leave much differentiation of contrast between the hard and soft tissues upon the film emulsion; while if the vacuum of the tube is just right, the teeth and alveolar process stop the rays enough to give good definition of the different tissues of the teeth and the cellular structure of the alveolar process upon the photographic emulsion.

This can be determined by the operator noting the color of the tube when he does secure a good radiograph and adjusting it the same, each succeeding time. A regulating vacuum tube should be used in all cases in this work to maintain the vacuum at a constant point. They are adjusted by a wire which extends from a projection upon one side of the tube out near the cathode wire running to the coil (Fig. 2 D). As this adjusting wire is brought near the feed wire to the desired distance, then the current turned on through the coil, a sparking will take place from the adjusting wire to the nearest feed wire (Fig. 2 E), which will reduce the tube to the proper vacuum, after which the film may be placed in the mouth and the exposure made. Sometimes it may be found difficult to reduce the tube; when that is the case the feed wire (Fig. 2 E) may be connected direct to the little metal ring (Fig. 2 F), to which the reducing wire is attached, then the current thrown in and pulled out of circuit as quickly as possible; this will reduce the tube to a violet color, but it will go up to the proper working density very quickly when the wires are adjusted for work.

Perhaps the best way to reduce the vacuum of the tube is to have a third wire (Fig. 2 H) connected to the projection upon the tube, which holds the usual vacuum regulating wire (Fig. 2 F). This wire is run back to the coil and fastened to a brass rod (Fig. 2 I) having a long hard rubber handle (Fig. 2 N). This rod may be supported by posts of hard rubber (Fig. 2 K) in a horizontal position lengthwise of the top of the coil and about six inches back of the secondary binding posts (Fig. 2 L). The brass rod is short, so that it extends but half-way between the terminal posts upon the top of the coil, but is joined to the rubber handle in the center and the wire is also connected to the brass rod at this point. To the outer end of the brass rod (Fig. 2 I) is attached a brass wire of about 16 to 20 gauge, which may be bent towards the terminal (Fig. 2 M), then when the tube is in operation and the third wire connected with the adjusting wire upon the tube, a sparking will take place between this wire and the terminal by the current passing from the tube through the third wire, the brass rod (Fig. 2 I) and its wire terminal to the terminal point (Fig. 2 M) upon the coil; thus the discharge of sparks will be back by the coil, between I and M, and not alarm the patient as when it occurs up by the tube, and besides the tube seems to run more evenly with the discharge having taken place back upon the coil. I am indebted to one of our prominent X-ray operators, Dr. S. B. Childs, for this suggestion. Different devices to accomplish the same result are used by coil makers on the later coils.

The spark gap may be adjusted by bending the wire at Fig. 2 I or moving the handle (Fig. 2 N) away from or closer to the terminal (Fig.

2 M). Of course, the adjusting wire (Fig. 2 D) upon the tube must be bent away from the wire (Fig. 2 E) a greater distance than the spark gap from I to M, otherwise the current following the path of least resistance will reduce the tube by travelling from D to E.

It formerly was the custom of some operators to look through the fluoroscope at one of their hands to determine the working condition of the tube. As many serious X-ray lesions have resulted from this practice, the operator who does this is, to say the least, foolhardy.

Duration of the Exposure.

The duration of the exposure should be within ten seconds, according to the volume of the current used, the vacuum of the tube and the thickness of the tissues. For instance, the lower teeth in a young child's mouth would require the minimum exposure; the upper teeth a little longer time, while in an adult the exposure of the upper molars through the thick process, zygomatic arch and muscles would require the maximum of time. With the powerful apparatus used today, the exposures may be made in a fraction of a second.

Head Radiographs.

For radiographs of the head I designed a plate holder which clamps on the head rest of the rhinologist's chair. The head rest is adjusted so as to bring the patient's head in position with the plate holder against the side to be radiographed; the tube is placed horizontally eighteen inches from the plate.

For radiographs of the temporo-mandibular articulation, the best position is with the anode of the tube just below the level of the mandible. The radiographs for the temporo-mandibular articulation with the coil drawing about twenty-five amperes, and the tube adjusted properly, should not require over thirty seconds, but may vary according to conditions and is only determined by experience.

The Film.

Next in importance to the generator is the photographic emulsion and the vehicle by which it is carried to the mouth. The best article that I have seen upon this subject was one by Dr. Weston A. Price, of Cleveland, which was published in the March Items of Interest, and I can do no better than to quote from this article:

"The difference in the densities of the dental structures between which we must produce photographic contrasts is so slight that it makes it practically impossible to get choice results with ordinary photographic film. We must pile up the light contrast by using several layers of emulsion on the same film. Nearly four years ago I put a great deal of work

on the production of such a film which has given excellent success and I believe is in general use for this work and is being manufactured by the M. A. Seed Dry Plate Company of St. Louis. It has three layers of emulsion, one upon the other and all are acted upon at once by the X-rays. It can be secured from them direct by specifying my name, or by asking for the special dental film. The celluloid is thick enough to prevent curling and yet sufficiently flexible for the purpose and is selected from specially prepared smooth polished stock, free from scratches. The conditions under which we use it require it to be covered with a waterproof, lightproof, flexible container, and for this purpose I have found nothing so satisfactory and convenient as the unvulcanized black rubber, which can be secured at any dental supply house."

I order the film, described by Dr. Price, in sheets four and three-quarters by five and one-quarter inches in size. Take two sheets of Klinert's unvulcanized black dental rubber, remove the cloth and place side by side with the edges slightly overlapping; this sheet is then about an eighth of an inch larger than the size of the film. Then take a sheet of the film and place it face to face, or emulsion to emulsion, on a sheet of sensitive bromide paper, or a sheet of film of the same size, so that the rubber will not come in contact with the sensitive emulsion of the film and cause it to deteriorate. (Paper will also cause the emulsion to deteriorate.) Next lay both on the rubber, then another sheet of the unvulcanized black rubber of same size as first is placed on top of all and the edges pinched together around the edges of the film. This makes a light and moisture-proof envelope which may be cut into smaller sizes and the edges of the rubber pinched together as cut; if this is done in a warm room the edges of the rubber will adhere quite tightly. Snip the corners of the film and pinch the rubber together over them.

This work must be done in a dark room, using a very weak ruby lamp, and even this light will fog the film if it is exposed for a sufficient length of time. It is also best to place the prepared film back in the tin box which contains the sheets of rubber and put the pieces of cloth in between the rubber envelopes to keep them from sticking together. It is very essential to keep the film in a lead lined box, as otherwise the X-ray will fog it, for the rays will pass through an ordinary wall or even a brick wall, and fog the plates. In an emergency I have used Kodak film doubled upon itself, covered with unvulcanized rubber and cut up as desired; but as Dr. Price explains, there is not sufficient body of emulsion to give good contrast. I have also cut up Kramer's X-ray plates and covered with rubber after placing the bromide paper over the emulsion, and have secured good results, but a piece of glass is too unyielding to use satisfactorily in the mouth.

The Envelope.

The rubber envelopes, however, are rather unsatisfactory in one particular, for unless great care is used to pinch the edges of the rubber together tightly around each small piece of film, they are apt to pull apart and allow light to fog the film; also should one rubber envelope touch another the two will be quite apt to stick together with the likelihood of tearing the envelopes and thus fogging the film when they are pulled apart; but it has the advantage over the paper envelope of being moisture-proof and having rounded corners instead of square. A good light and waterproof envelope with round corners, which would fit the edges of the film quite closely so as not to occupy an unnecessarily large space in the mouth, would, I believe, be superior to the rubber in that it could be used in the film holder to greater advantage.

Danger in the X-Ray.

There is grave danger to the operator who is continually exposed to the influence of the X-rays, for the reason that the effect of the rays is cumulative, so that one dose piled on top of another will eventually cause serious trouble. In the early days of the use of the X-ray the operators did not realize this and some lost their hands, and a few their lives, from working under the influence of the ray. Nowadays no X-ray operator, who has had enough experience to realize what he is doing, will subject himself to an exposure while making a radiograph, and all the operators with whom I am acquainted refuse to make an examination by the use of the fluoroscope, unless thoroughly protected by a lead screen. I am sorry to say that some of my orthodontist friends, in their eagerness to secure good radiographs, have held the film in the patient's mouth, thus being exposed to the rays each time that patient was exposed. I wonder what you would think of a physician who would take a dose of medicine each time every one of his patients did? I must confess that I was quite careless when I first began to make radiographs and used to hold the film in the patient's mouth when making an exposure, and also would look at my hand through the fluoroscope to determine the working condition of the tube. Finally my hands began to feel as though they were suffering from frost bite, after making several exposures in a day, and I was obliged to give up holding the film in the patient's mouth and to design a dental X-ray holder for this purpose.

It would require too much time to enumerate the many cases of burns which have resulted to the operator from this continued exposure. In my own case I seem to have escaped with no more serious effect to my hands than numerous warts and ribbed finger nails. I have been able to remove all of the former except one, by cauterization; but many

operators have not been so fortunate, one of my friends having had over forty operations upon his hands for cancers, caused by repeated exposures to the X-ray. Mr. Baur, of Green & Baur, of Hartford, Connecticut, who were probably the first in this country to make a focused tube, was constantly exposed in the early days of the X-ray, as was his partner, Mr. Green. They noticed that the skin upon their hands was irritated, but did not attribute it to the X-ray until they saw a newspaper account of an X-ray burn. This set them to thinking, and they began to treat their hands, but in the case of Mr. Baur it was too late, and his life was sacrificed to the cause of good X-ray tubes. Mr. Green was more fortunate, but was obliged to visit a physician every evening for seven years to have his hands dressed, cauterized, etc. To-day the only good piece of skin upon his left hand is one about the size of a silver dollar, which, after a cancerous growth had been removed, was grafted from his thigh. He also had a cancer between his eyes, which had penetrated one frontal sinus and gone on through the skull until it had all but reached the brain. Mr. Green was treated by Dr. C. A. Porter, surgeon of the Massachusetts General Hospital, who published a description in pamphlet form of the treatment in forty-seven cases of X-ray lesions. I think that a copy may be secured by addressing him at 254 Beacon St., Boston, Massachusetts. There are also a number of reputed instances where the X-ray operator has been made sterile from the influence of the X-ray; so, knowing all this, the operator is foolhardy to expose himself to the ray when he can be protected.

Danger to the Patient.

With the short exposure of the present day, the danger to the patient is nil, for the patient is exposed to the rays but two or three times, where the operator would be exposed hundreds; yet people have been burned and crippled for life with but one exposure. Most of these cases happened during the early days of this work when the danger was not understood and when the apparatus was not nearly as efficient. When I first started experimenting with the static generator, it required eight minutes to make a proper exposure in the upper bicuspid region, while to-day it seldom requires as many seconds. We are using a larger volume of current and making the exposure but a fraction as long as formerly. The operator has no right to take unnecessary risks of injuring a patient. It is possible to protect a patient so that the only part exposed is the one which we wish to radiograph, and this should always be done.

Protection to the Operator.

In making dental radiographs, as I have indicated, the operator often has held the film in the patient's mouth with his own hands, receiving the same dosage as each and every patient. Other operators have tried to have the patient hold the film, but usually with very unsatisfactory results, as the film would either not be held in the proper position to give the minimum amount of distortion of the roots, or it would slip out of place. The results were very unsatisfactory indeed.

Dr. Weston Price devised opaque rubber gloves, sleeves and apron made of rubber cloth, into which there seems to be incorporated some metallic oxide, but these do not cover the operator's person perfectly, and I cannot see what it would profit a man to save his hands and burn an arm or his head, and it has been reported that some operators have had their feet burned while standing behind a lead screen which did not reach quite to the floor; besides the rubber gloves are so thick and clumsy that it is practically impossible to hold the film satisfactorily in the patient's mouth. Some operators have gone into the matter of protection very thoroughly, having constructed a lead lined booth or box, in which are placed the switches to operate the X-ray generator and having a small window of lead glass through which the operator may watch the tube and patient. This is probably the most perfect form of protection to the operator. Others are using a screen which is covered with X-ray lead of the proper thickness to completely stop the rays. The operator can stand behind this screen and operate the switches and watch the tube through a lead glass bull's-eye, in comparative safety, for the rays are direct rays and cannot be deflected.

Protection to the Patient.

To protect a patient, the physician will often place a metal box or lead glass shield around the tube. The tube for general work over the body is usually placed in a horizontal position, with the anode turned down so that the rays are projected toward the floor. Beneath the tube and eighteen or more inches from the anode is placed the plate, and over that the part to be radiographed. In the case of a body radiograph, the compression diaphragm is used between the tube and the part to be radiographed; this not only cuts out secondary rays but it presses the patient's body down, or irons him out thinner, so that a better radiograph is secured, and when a lead glass shield is used in conjunction, the only part of the body exposed to the influence of the rays is that of which the exposure is being made; but in dental radiographs it is different; instead of lying on an operating table the patient

is sitting in a chair—unless the operator has a compression diaphragm tube stand—and the tube is elevated to the proper height to make a radiograph of a certain tooth. The most satisfactory method of protecting patients that I have found, after considering the different ways of covering the patient's body and face with an opaque cloth, or with a lead sheet having a hole placed over the area which we wish to radiograph, has been to use a Price shield, made of heavy rubber compound (G, Fig. 2). This shield is flexible, and by cutting off the part which goes over the back of the tube, it can be put on and removed from the tube quite easily and tied in position with tape. It has an opening about three inches in diameter, over which fit a series of stops or diaphragms down to about three-fourths of an inch in diameter. This cuts out all the rays going toward the patient except those which pass through this small opening to the surface which we wish to radiograph. The anode of the tube is turned toward the tooth to be radiographed with the tube in a horizontal position and its long axis parallel, as nearly as possible, to the surface of the film. You must remember that most of the rays are projected from the front of the anode, not as many going back toward the operator, but back of the tube by the switches, a lead screen is placed, behind which the operator stands.

I have made hundreds of dental radiographs, a number of the head and other parts of the body, and have been so fortunate as never to have a patient receive a burn.

Film Holder.

Apparently I am not as susceptible to the influence of the X-ray as the majority of operators, yet I have reached a point where I do not dare expose myself to the ray at all, and will not now do it. When my hands began to trouble, as mentioned previously, and friends were advising me to give up the work entirely, I began to cast about for a way of holding the film in the patient's mouth which would eliminate all danger to the operator, be easily adjusted for different positions, and still hold the film in close relation to the tissues just as though the operator held it with his fingers. After considerable experimenting, I devised a holder which is illustrated in Fig. 3.

This holder is composed of a rubber block, which is designated as (14) in the illustration, the rubber block to be held between the teeth, and to prevent slipping velum rubber is vulcanized to the upper and lower surfaces. The block has a horizontal slot (16) in its central portion through which a bolt (13) having a winged nut (19) is passed. The inner end of the bolt is to receive the arm (10) of the aluminum film holder (5). The arm has a slot (12) cut to pass underneath the

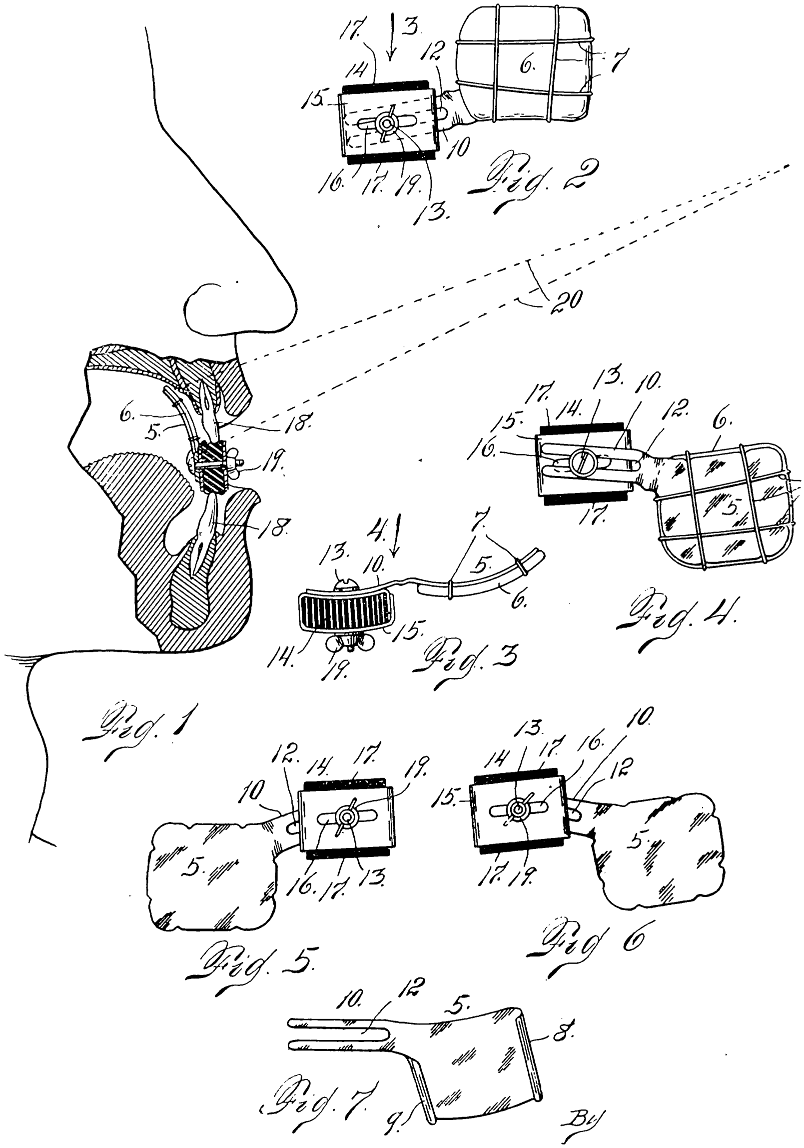


Fig. 2

head of the bolt (13), then when the nut (19) is tightened the aluminum holder (5) is fastened securely to the rubber block.

Several different sizes and shapes of the aluminum holders may be fashioned for the different sections of the mouth which we wish to radiograph, but in practice these may be simplified to about four forms, each set in three different sizes, as a certain shape which would hold the film for the right upper molars and bicuspids, would with a little bending, hold it for the left lower molars and bicuspids—and the same is true of the opposite sides of the upper and lower arches—while another shape may be used for the upper or lower incisors, though it is best to make these in lefts and rights, as it is desirable to keep the rubber block near the front of the mouth when radiographing in the region occupied by the lateral incisor, cuspid and first bicuspid.

The holders may be made of aluminum plate of about 20 gauge, which is flexible enough so that the holder may be bent readily to conform to the tisues and the handle bent in and out to adjust the holder to the correct angle. The anterior and posterior edges of the holder may be bent over to receive the edges of the rubber envelope which contains the film, but there is some danger, unless the edges of the rubber are very carefully pressed together, of pulling the edges of the rubber apart and partially fogging the film. The film holder may be flat, with notches in its edge and a rubber band, a size larger than the election bands, slipped around the films and holder.

With a little experience this film holder may be adjusted to different positions in the mouth and even carried back between the tongue and the teeth to radiograph the third molars. If the patient is instructed to raise the tongue and then the film holder slipped in beneath the tongue, passing downward and back, it will lay close to the tissues to be radiographed.

Some of my friends have been waiting for the appearance of this film holder on the market. To these I owe an apology, for besides trying it out in difficult cases and with hard usage, I have been too busy with other work to arrange for its manufacture, but intend that it shall soon be possible for all X-ray operators, who may desire, to secure one.

The Position.

The film in its moisture and light proof envelope is slipped upon the aluminum holder which carries it to the desired position close to the tissues which are to be radiographed. It is known that the closer the film is to the tooth or tissues which are to be radiographed, the more accurate the result, for a radiograph is but a comparative study of the shadows of tissues varying in density, so the closer we can place our photographic emulsion to the object which we wish to radiograph, the sharper the

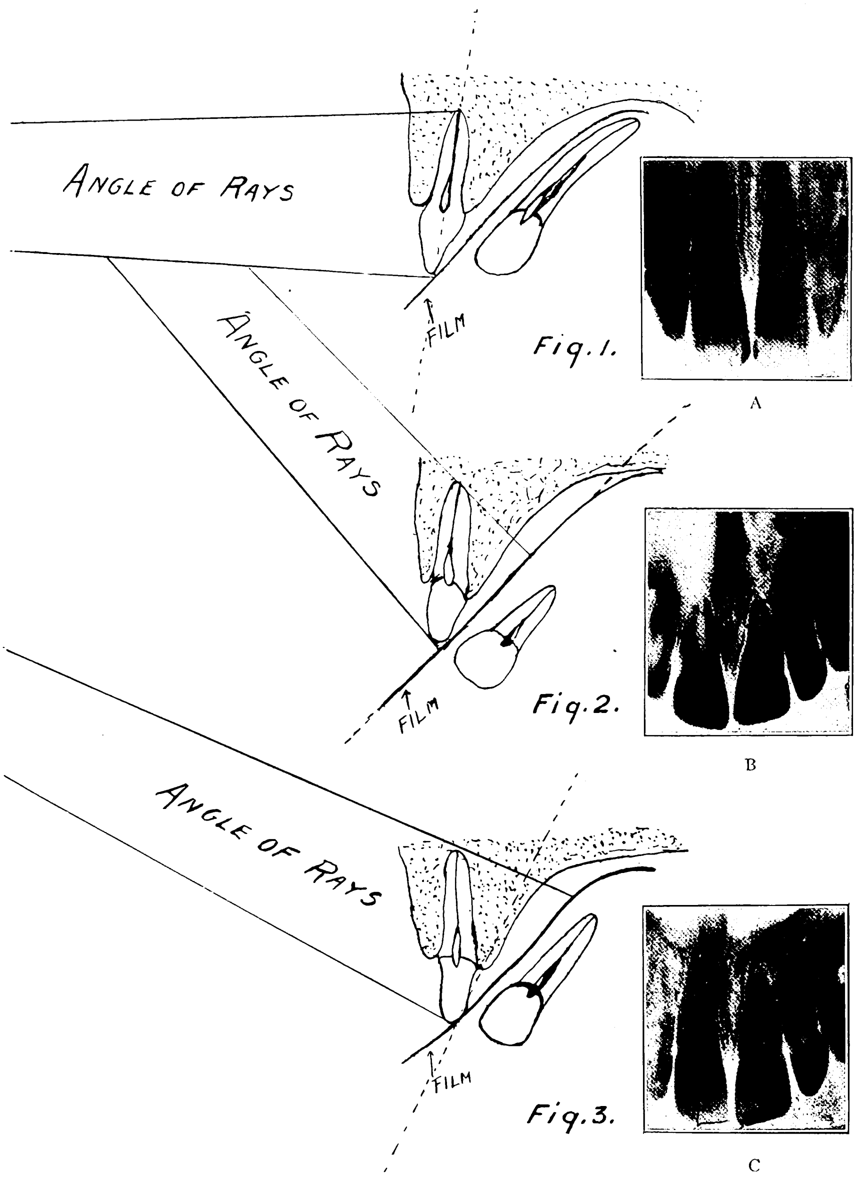

ANGLE OF RAYS
FILM
Fig. 1.
A
ANGLE OF RAYS
FILM
Fig. 2.
B
ANGLE OF RAYS
FILM
Fig. 3.
C

Fig. 4

shadow. You can very easily prove this by holding a finger between a sheet of paper and some artificial light. You will find that the closer you hold your finger to the paper the sharper the outlines of the shadow, and that upon moving the finger away from the paper this sharpness disappears in proportion as the distance increases. This holds true in our radiographic work: in the making of radiographs of the lower teeth we can secure the most accurate representations by running the film down between the tongue and teeth so that it is parallel to the long axis of the teeth; but this is not the case in the upper arch, for if the film is placed parallel with the long axis of the teeth, the upper edge touching the wall or roof of the mouth some distance from the apex of the roots, will cause the film to be held quite a distance from the crowns of the teeth so that the image of the crowns will not be as sharp. Dr. Price explained this very nicely in the article from which I have quoted, and I have his permission to use his illustration, which is the best that I have ever seen, showing the relation of the tube to the upper teeth and the film. (Fig. 4.)

Dr. Price says: "We all know how seldom our own shadows represent our true height or shape because the source of the light and the surface receiving the shadow are not in the proper relation to the object casting the shadow. Each of these three factors must be in correct relation to the other two, but one of them, the teeth and surrounding structure casting the shadow, are by their peculiar position practically fixed and the others must therefore be adjusted to them.

"The shape of the arch prevents one placing the film in the best position to receive the shadow, viz: in parallel planes. This produces a distortion which must be overcome by placing the source of the light in just the position that will shorten the shadow just the extent that will correct the elongation of it produced by the film not being in a parallel plane to the roots of the teeth."

In Dr. Price's illustration Fig. 4, No. 1 shows the result of taking a radiograph with the tube opposite and at right angles to the long axis of the teeth, and shows the distortion by elongating the shadow of the roots just as our shadows are distorted upon the sidewalk when the sun is low in the sky. The film in this instance is adapted as closely to the tissues upon the lingual side of the teeth as possible. Fig. 4, No. 2 shows the distortion caused by placing the tube so that the rays will fall at right angles to the plane of the film, thus greatly shortening the shadow of the roots, just as our shadows are shortened at noon in the summer time when the sun is almost directly overhead. Fig. 4, No. 3 shows the correct position of the tube in its relation to the teeth and the film; that is, the tube just half way between the positions which it occu-

pied in the two first illustrations, so that the rays fall at right angles to a plane drawn midway between that of the long axis of the teeth and of the film and giving the correct length of the roots of the teeth upon the film.

Position seems to have been a great stumbling block to our medical friends who have tried to make dental radiographs. If we will but remember the simple rule of having the tube elevated just enough in our radiographs of the upper teeth so that its rays fall at right angles to neither the teeth nor the film, but to a plane drawn midway between them, and then if a film holder, which holds the film close to the tissues to be radiographed, is used, the difficulty experienced in distortion of the image will be practically eliminated.

Some patients will flinch or jump a little when the current is first turned on through the tube. Of course this motion will produce a "fuzzy" radiograph just as it will produce a "fuzzy" image when photographing a face; so it is well to first turn on the current for a second or two to allay their fears, then the film may be placed in the mouth and the exposure made.

Stereoscopic Radiographs.

Stereoscopic pictures of the teeth and jaw may be made satisfactorily. For this purpose efficient apparatus has been devised by the different X-ray equipment manufacturers.

Radiographs of the Head.

In making radiographs of the temporo-mandibular articulation it is only possible to secure one side accurately upon the plate at a time. In experimenting with the skull to find the best relation of the anode of the tube to the mandibular articulation and the plate, in order to secure the most accurate radiographs, I made exposures upon plates from three different positions. One a bull's eye opposite both temporo-mandibular articulations. Another with the tube raised so that it was above the temporo-mandibular articulation and with the anode turned down so that it pointed toward the side against the plate. Another plate was exposed with the anode of the tube at a point just below the mandible and showing the temporo-mandibular articulation nearest the plate quite sharply. The last seems to be the best position.

Development.

Do not send X-ray exposures to a photographer to be developed unless you wish to court failure, for the technic is quite different from ordinary films or photographs; then, too, you cannot be as certain of the cause of failures and learn how to guard against them.

I have used Ortol and several other preparations in developing Seed's

Dental X-Ray Film, but find that the Eikonogen developer answers my purpose the best. Made as follows:

Sodium sulphite, three ounces.

Potas. carbonate, two ounces.

Eikonogen, two ounces.

Aqua, two quarts.

Dissolve in boiling water and filter when cool.

Secure fresh pure chemicals in original packages from photographic supply house.

One part of the developer is used to two or three of water; temperature about sixty-five in summer and not over seventy in winter. If the exposure is normal it is best to give the film twenty minutes in this developer. In order to bring out the contrasts and have the developer act upon the three layers of emulsion, it is best to use weak developer, as I have indicated, and carry on the development for a longer period. The bromide paper may be developed in the same solution, but as the detail is not very sharp it is usually best to throw it away.

The emulsion is so thick that the image of the teeth cannot be seen by looking through the film at the ruby light, but by looking down upon the emulsion the image of the teeth will be shown; but it is best to keep the tray covered or protected from the ruby light by some screen like a piece of cardboard until development is completed.

With a little experience the operator, knowing the density of the tissues radiographed, the length of exposure given and the strength of his developer, can tell how long to leave the film in the developing solution to obtain the best results. After the film is developed and rinsed, it is placed in an acid fixing solution which hardens the emulsion as well as fixing. Then the films are placed in a large tray and washed in gently running cold water for an hour; they may then be rinsed to wash away any minute specks of detached emulsion which may be upon their surfaces, then stood on edge upon a blotter in a tray to dry.

Lantern Slides. From a good radiograph fine lantern slides can be made by contact exposure. It is best to rather under expose the slide and bring up the image carefully in development. The glossy velox paper makes excellent prints from good radiographs.

Things Proved in Orthodontia by Use of the X-Ray.

Here are some of the facts which I think I have proved by the use of the X-ray. We were told years ago that the bone is absorbed in front of the moving tooth and that new bone fills in behind the tooth. Of course this is true to some extent, but the greatest change is in the

bending out of the labial alveolar plate in the outward movement of several teeth, and a stretching of the weaker portion of the alveolar process, which is the cancellated structure of the bone in between the plates and between the tooth sockets. Dr. Frederick B. Noyes first suggested that this was probable, and I think I have proved it in radiographs of a number of different cases, the first of which I showed at the Chi-

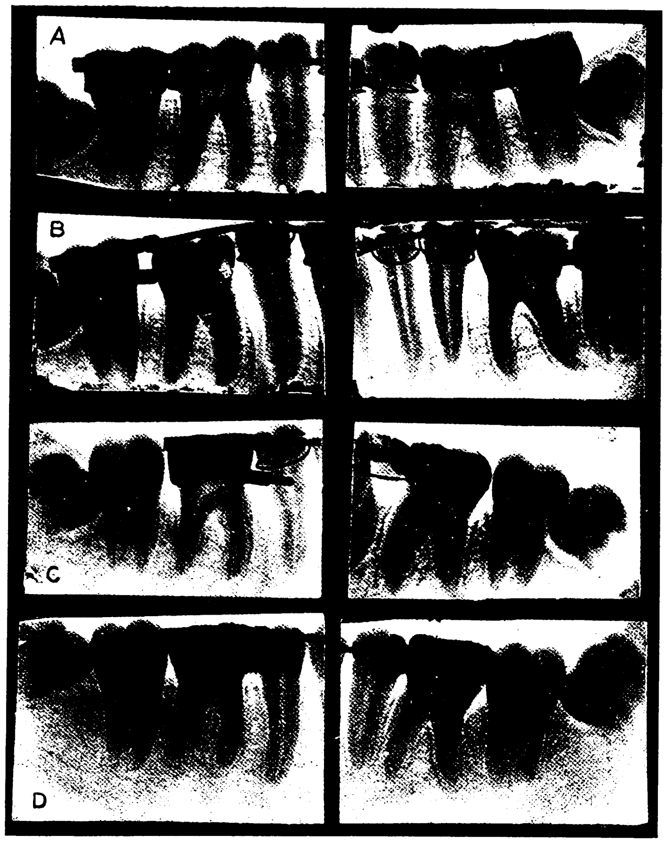


Fig. 5

cago meeting of the American Society of Orthodontists in 1905, and asked the members if they did not think that this was what had taken place. (See Fig. 5 B.) Between the comparatively dense plates of the first and second molar tooth sockets, on the left, there is shown a stretching of the weaker cancellated alveolar process, while on the right the same is shown between the second bicuspid and first molar.

Distal Movement of Molars.

The second fact which I have proved to my own satisfaction is that in the distal movement of the first and second molars, as in the treatment of class 3 cases (Angle), we do not impact the third molars,—as was claimed by Dr. M. H. Cryer in the *Dental Cosmos* of September, 1904,—or if they are impacted, increase the impaction, but that in reality when we have tipped the crown of a second molar back over that of the third, and then followed it up by tipping back the first molar, in all cases of which I have a record, the third molar has come up into place as nicely as though we had not moved the anterior molars at all.

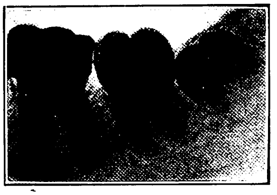


Fig. 6

Fig. 5 also illustrates this point: (A) shows the lower molars in a class 3 case before pressure was applied to move the second molars back; (B) just after the second molars were moved back and tipped over the third molars; (C) after the first molars had been driven back against the second, and (D) nearly one and one-half years later with the third molars coming up normally.

Fig. 6 is of a typical class 3 case, in which the crown of the lower second molar was tipped back into normal mesio-distal relation with the upper, to be followed by the first molar, and this radiograph taken about a year after treatment shows that the third molar has not suffered.

Abnormal Frenum Labium.

The third point which the radiograph settled was that it is not necessary in abnormal frenum cases—as has been recommended by several men, and was by Dr. Varney Barnes at our meeting in 1905—to currette the surfaces of the bone along the suture between the intermaxillary bones, in abnormal frenum cases, for the reason that the abnormal attachment of the frenum labium was due to the suture being open. Upon making radiographs of a number of frenum cases I discovered that the suture was not always open, but was sometimes closed with the inter-maxillaries in perfect juxtaposition, while radiographs of some cases in which the frenum was normally attached

with the central incisors close together, revealed the fact that the suture was open; in fact, some of the largest sutures were in cases where the frenum was normal with the central incisors close together.

I reported some of these cases in *The American Orthodontist,* Vol. 1, No. 1. Since then I have secured radiographs of quite a number of abnormal frenum cases, as well as an equal number of normal—about fifty of each—and I find that the suture is open in about two-thirds of the cases regardless of the attachment of the frenum labium or of the separation or non-separation of the central incisors, and that the suture is closed with the inter-maxillaries in perfect juxtaposition in about one-

Fig. 7

Fig. 8

third of the cases of abnormal attachment of the frenum and separation of the central incisors, and that we have the suture closed in no greater proportion of cases where the frenum is of normal attachment and the central incisors close together. From this I conclude that the abnormal attachment of the frenum labium, with the consequent separation of the central incisors, cannot be due to an open suture between the inter-maxillaries, and therefore all the surgical procedure necessary is to destroy the abnormal attachment of the frenum labium, and that curretting the surfaces of the bone along the suture between the inter-maxillaries is unnecessary. All that is left to do is to draw the centrals together, then allow them to separate slightly on the day when the operation of dissecting away the abnormal attachment of the frenum with an electric cautery is performed, after which they may be drawn together immediately and the scar tissue will help to retain them.

Missing Bicuspids.

I have also discovered that in many cases the bicuspids are missing, the germ apparently having been suppressed. While I have not a record covering enough cases so that I can speak positively, yet my experience has been that there are just as many bicuspids that fail to develop as there are lateral incisors. The bicuspid most likely to be missing seems to be the lower second, therefore we should be

very careful in advising the extraction of a temporary molar without first having it radiographed, and not recommend its removal unless we can see or feel its successor. In one of my earlier cases I allowed a second temporary molar to be extracted, and you may imagine my mortification when later on I made radiographs and found that the bicuspid was missing and that the patient would be obliged to wear an artificial substitute, which could not be as good as a well preserved temporary molar.

Fig. 7 is of a case in which, after the discovery of the absence of the second bicuspid, on account of the absorption of the roots of the temporary molar, I advised the trimming down of the crown of this tooth

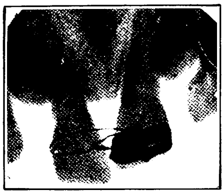


Fig. 9

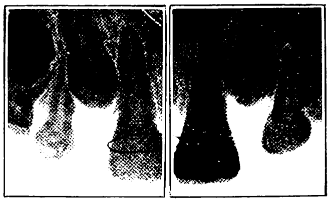


Fig. 10

to the width of a second bicuspid and closed the space thus made by moving the teeth together. It is still doing duty, and four years have elapsed since treatment. It may be of interest to note that the lower second bicuspid on the opposite side of the mouth was present, but impacted, with its occlusal surface lying low down against the anterior surface of the mesial root of the first molar, so that the crown of the tooth, which was the only portion formed, was lying in a horizontal position. After the removal of the second temporary molar over this tooth, nature, assisted by an appliance, brought this tooth up into place; then it was rotated and is now doing good service. Where the roots of the temporary molar are not absorbed (Fig. 8) I do not recommend trimming the crown on the mesial and distal sides on account of preserving the contact point, but save it full size as it will probably last indefinitely.

Interpretation of Radiographs.

In closing let me warn the beginner that reading a radiograph for diagnosis is of the greatest importance, and that many mistakes will be made until one acquires knowledge through experience. For example, let the beginner examine the radiograph reproduced in Fig. 9. It is from a partly treated abnormal frenum case, a girl ten years of age. Let him note that the suture between the intermaxillary bones is closed; also the position of the lateral incisors;

see, too, the pulp stones in the pulp canals of the central incisors. Now let him examine the radiographs of the same case shown in Fig. 10 but taken "around the curve" over the cuspid region. From these he can see that the lateral incisors are missing; that the cuspids are pointing toward the lateral incisor position and that the pulp stones were only imperfections in the film.

Let us draw a moral from this, and in all important cases make two or three exposures from slightly different positions, especially when radiographing around the curved part of the dental arches.

Discussion of Dr. Ketcham's Paper.

Dr. Ellis.

I feel honored to open the discussion of this paper by Dr. Ketcham, who has been essentially our host at this year's meeting. The paper has been as interesting and instructive as has been this good city of Denver, where we have been entertained so royally.

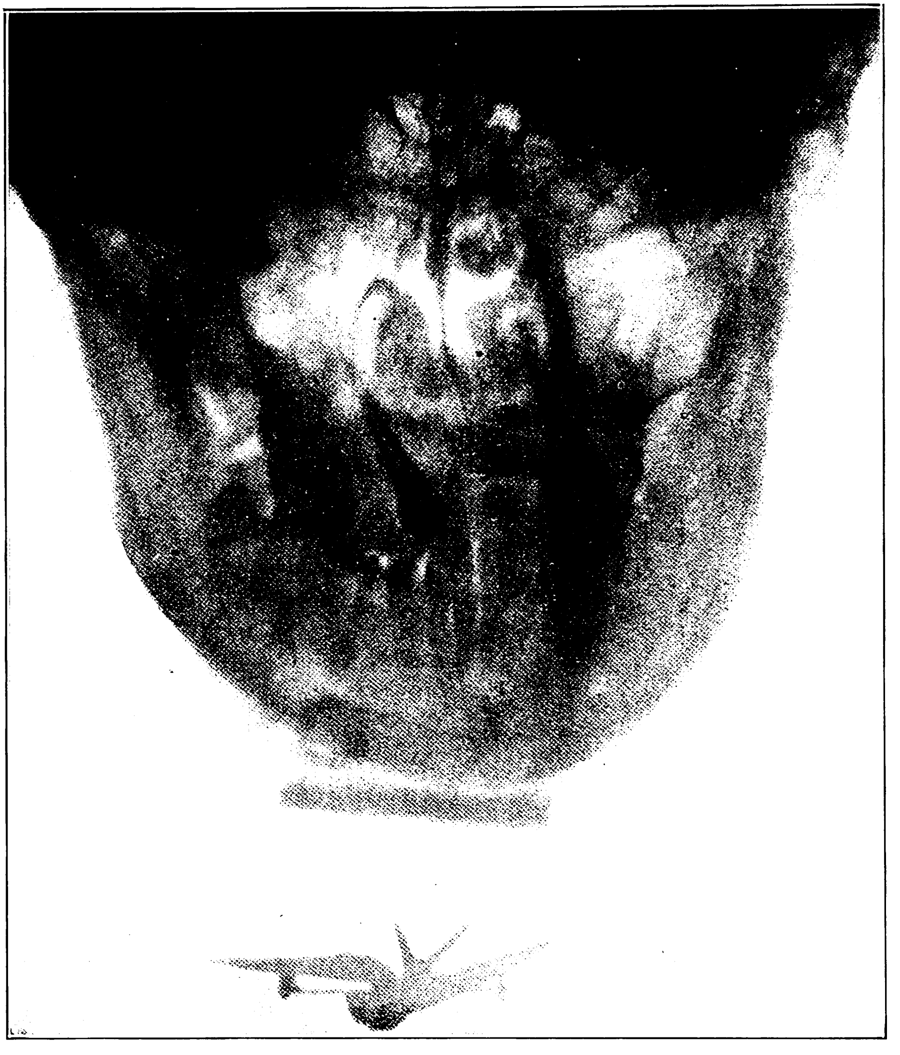
We are extremely fortunate in having him present this subject to us, because it is the result of many years of his own clinical experience, whereas my experience and that of many others is limited to the diagnosis of the need of a radiograph and the reference of the actual work to another, although when we have the radiograph before us we must have some little experience in its interpretation, as an expert opinion is as important as a good picture.

The essayist has made his leading points so clear, and proved them so conclusively by his slides, that it is hardly necessary for me to elaborate upon them. He has shown us that curretting between the intermaxillary bones is unnecessary, which is gratifying to me, for I have limited my own operation to lancing and cauterizing.

In regard to missing teeth, as far as my own experience goes, the bicuspids are the leaders—about equally distributed between the upper and lower.

It is gratifying to know that the third molars are not impacted in class three cases. However, I think that we move the teeth distally more seldom than we realize, in reality, moving the upper teeth mesially even in those cases where considerable distal movement of the lower molars is attempted.

I have always felt considerable timidity in handling or getting within reach of the X-rays, but with the recent perfection of the apparatus I find there is very little cause for fear. The short exposures of 15 seconds or less that are now necessary to obtain a good radiograph and the low strength of current, produces no danger of burn or other mal-effects.



In a radiograph of the skull a short exposure of five seconds will show the sinuses, as a longer exposure will not. It may be deliberately undertimed, and by using an intensifier in developing, the picture will come out satisfactory in every respect. The operator thus saves the patient from undue exposure to the influence of the rays.

In those cases where the film shows too limited an area, or where it is impossible to orient the rays upon the film properly, the plate may be used, making an exposure of the entire face. I have used this external method (plate outside the mouth) very successfully. It is obtained by placing the patient's face against the plate, pressing the nose flat until the bridge is in contact, thereby giving equal focus to the sinuses, etc., the rays, of course, coming from behind.

I have such a negative here (Fig. 1), made to locate an unerupted cuspid. It is an unusually clear negative and rather interesting in some ways, as well as for the purpose for which it was made. The exposure was very short, and made with a 2 K. W. transformer, working on 110 volts, 60 cycles, 3 phase current.

Dr. N. S. Hoff.

I am not a Roentgenologist, and cannot add to the technical value of this discussion. We cannot overestimate the value of the radiograph in diagnosis, not only in orthodontia but in other branches of our work. The question was raised this morning, for example, as to the methods of diagnosing pulp conditions. We may use the X-ray apparatus with very good results in this connection, in a very satisfactory way, that I will not take your time to discuss here. The value of it, however, is very often lost because of defects in methods of manipulation, producing pictures which do not represent conditions as they are. Very many of those made for me, or those that I have seen, are so evidently distorted as to furnish pictures from which we may only guess the actual conditions. They form very good data for guess work: better than we could get in any other way, perhaps, but it sometimes requires an expert guesser to interpret the radiograph properly. So I believe the use of this means of diagnosing conditions is not to be relied upon, generally. It should not be utilized by every practitioner, for the reason that very few of us are willing to take the time to learn the technic or go to the expense of providing ourselves with proper appliances that would enable us to accomplish results that are desirable. I know enough of this work, although I do not do it myself, to realize the necessity for accuracy. I feel that it should be relegated to those who have the skill and are willing to take the time, and have the means for developing these pictures in the best possible way for us. I agree that we cannot refer these patients to the

professional Roentgenologist, who is not in sympathy with our work, as he does not know just what we want to find. We should have dental operators who are proficient in this subject. Dr. E. B. Lodge, of Cleveland, is doing this better than anyone I know of. He produces as good results, so far as accuracy is concerned, as I have ever seen. We should have more men doing this work in different parts of the country, some one in every city. Another reason for referring the work to an expert is the fact of the dangers. I have had recently in my own experience, a very sad case, where an acquaintance, perhaps one of the best known Roentgenologists of the country, has recently been committed to the insane asylum in our State, and is hopelessly incurable. His ability to handle this subject technically, and in every way, was wonderful, and the fact that he has succumbed to its dangers has been to me a very great warning. We should not take up this work with portable appliances. We cannot do the work and get the best results with indifferent apparatus, and I do not quite fancy the idea of our friend Ketcham having X-ray work done in his operating room. I should have a separate room exclusively devoted to that work, and have all the apparatus there, surrounded with all the safeguards and protection possible. I certainly should not have it in my operating quarters, as the cluttering up of the office is an objection, and the possibility of harm and danger should not justify anyone in fitting up an office in that way.

I rather like the little apparatus Dr. Ketcham showed for holding the film in the mouth. That, perhaps, will answer in very many of the cases. Dr. Honeywell, who is doing this work in Ann Arbor, showed me a device he uses which I think might avoid the necessity of the clamp apparatus of Dr. Ketcham. He rolls out a piece of thin aluminum, slips it in the envelope containing the film, bends it to adapt it to the mouth, and brings it in actual contact with the teeth and other parts of which he wishes to make the picture. Either the operator or the patient may hold it in position with the finger. Some pictures made in this way were remarkably free from distortion, because he had gotten the film close up to the teeth he wished to radiograph. In the lower third molars he was able by means of this device to carry the film down on the lingual side of the jaw opposite the tooth, so that he obtained remarkably good, sharp outlines of the tooth and its relation of the jaw.

As to the use of films and plates, I have never been able to get plate pictures of the entire skull that were of very great value to me in orthodontia work. They are usually obscure because of the number of dense bony structures shown in the plate. They overlap so much that they give too much distortion. The picture of Dr. Ketcham's showing the condyloid articulation was, perhaps, as good a picture as you will ever see. It

is very seldom that you can get all the relations by any such manipulation of the rays, where you try to take the whole skull, although such pictures may be very valuable for some purposes. The picture Dr. Ketcham showed, of the influence the movement of the molar teeth had in impacting the third molar, was to me quite interesting. I wish we could have more evidence of the injurious influence, or of the actual results of that kind of work. I recall Dr. Cryer's criticism, but I am in doubt whether there could be anything in it or not, particularly where the work is done for very young patients, because of the fact that the jaw bone itself (particularly the alveolar process) is sufficiently elastic so that it will yield and allow for the development which we desire, and these pictures that the doctor has shown us, illustrate the influence secured to stimulate the interstitial growth or elongation of the jaw bone, which is the important factor in the growth of the jaw bone. Therefore, I do not share Dr. Cryer's fear that we may impact third molars by orthodontic procedures, because the irritation of the roots of the molars in moving them, and the continuous stress we have from the use of the intermaxillary ligatures, will produce a sufficient amount of irritation to induce development of the bone itself, and cause an elongation which will not only affect the teeth being moved, but will cause development around the third molar and influence its eruption from its crypt. I think proper application of force is inclined rather to influence the development of the jaw, and so overcome impaction rather than if there were no such stimulus applied. The pictures of Dr. Ketcham are very convincing, although I should like to see more evidence than this one case, but I see no reason why it should not logically occur. Taking into consideration the developmental process in the child, there is no reason why the jaw bone should not develop sufficiently to give place for all the third molars. I thank the essayist very much for bringing this to our attention.

Dr. Ketcham.

I wish to compliment Dr. Ellis on the beautiful radiograph of the head, which is being passed around the room. It shows deflected septum, turbinates, impacted cuspid, third molar (which may be impacted), lady's pin at the throat, etc. Evidently it was made by an operator who is making radiographs for physicians; one who is not accustomed to making dental radiographs. Such an operator usually wishes to make a head radiograph, as he is accustomed to the technic, but no head radiograph is as good for our purpose as a good dental radiograph. However, it is a splendid picture. The patient's face was placed against the plate, and we have a radiograph which shows the nasal space very beautifully. I have been

wishing to take time in my cases of constricted nasal spaces, to make such radiographs before and after expansion of the dental arches.

Someone I think asked about the operation on the frenum. We still perform the operation of dissecting away the abnormal attachment of the frenum just as we used to do, but we do not go in between the inter-maxillary bones and currette in order to get the two bones to close the suture.

Dr. Hoff spoke of having the X-ray coil and apparatus in a room separate from the operating room. That is proper. There is no objection, however, to having it in the operating room aside from sentimental reasons, if one has the space for it. I have a separate room for this work. It is, however, just as dangerous in one room as in another. The rays will penetrate partitions or brick walls. To protect people in adjoining rooms perfectly, you would be obliged to have the operating room fitted with metal walls. The tube shield and lead screen are principally to protect the patient and operator.

The Movement of Teeth Bodily.

By Dr. Ray D. Robinson, Los Angeles, Cal.

The writer claims no originality for principles or appliances, but describes an application of principles long recognized and accepted to better produce certain desired movements of the teeth.

By the use of the expansion arch of Angle, and others of similar principle, the molars and bicuspids are tipped buccally when an expansion of the dental arch is accomplished. This results in a faulty occlusion of the grinding surfaces of these teeth, which is undesirable. This can be avoided and each tooth moved bodily, either buccally or lingually, at will by making the application of force in the following manner:

In a case requiring expansion of the molars and bicuspids, soldered bands of iridio-platinum are prepared for each tooth to be moved. To the buccal surfaces of these are soldered tubes, parallel to the long axes of the teeth, to extend beyond and buccally of the gum margins. The bands are cemented to place. Next an iridio-platinum arch is prepared to which are soldered spurs in the proper places to enter the tubes when the arch is put into position. The tubes should be two sizes larger than the spurs. This is quite necessary as there is danger of breaking the spurs from the arch, when forcing them to place, if the fit is accurate. With an appliance prepared in this manner the teeth can be moved buccally, bodily. The apex of the roots can be moved as far as the crowns. (Fig. 1.)

If it is desirable to move the apices of the roots farther than the crowns, this can be accomplished by soldering the spurs to the expansion arch at such an angle that the free end of the spur will stand farther away from the tooth than the soldered end when the arch is placed in the mouth, and allowed to be at rest. (Fig. 2.) When the spurs are forced into the tubes the arch must be forcibly twisted and the torsion exerted by the arch will then move the apices farther than the crown.

In other words the relative extent of movement of the apex and the crown will depend on the degree of torsion exerted as compared with the amount of expanding force, and the relation between these two forces is under the control of the operator at all times.

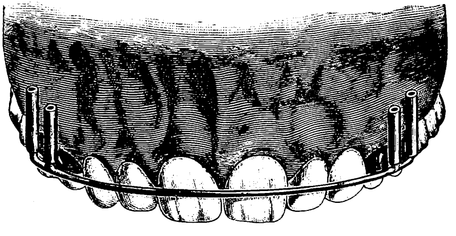


FIG. 1.

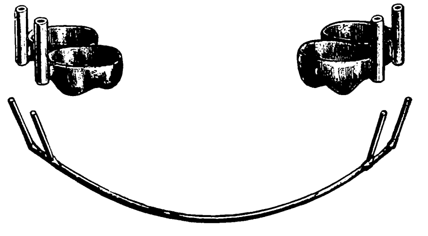


FIG. 2.

It is, of course, to be understood that if any great movement of the apex is desired, beyond the movement of the crown, that the spurs are to be removed and resoldered at a greater angle every few weeks.

Another class of cases in which a similar appliance is indicated is that in which space must be secured for a tooth, as is well illustrated by the first bicuspid being nearly or quite in contact with the lateral and the cuspid in buccal and infra occlusion with little or no space for it to assume its normal position. By the use of the Angle arch space can be secured, but in doing so the lateral is tipped mesially and labially, and the apex of the root is left in the position which should be occupied by

the cuspid. But if the lateral be banded as described above, and the usual anchor band placed on the first bicuspid, and a threaded iridio-platinum arch is prepared and to it soldered a spur to engage in the tube on the lateral, the desired space can be secured without the least tipping of the lateral, and the cuspid is much more readily moved to place because the lateral root is not in its way.

It is recognized that there are other methods of moving molars and bicuspids buccally, bodily, as by the use of the square tubes on the anchor bands, suggested by Dr. Kemple, and by the split tube as devised by Dr. R. Ottolengui, but by the use of either of these only one tooth on each side is moved bodily and the others are tipped.

I have experimented with this appliance for three years and I believe the results accomplished warrant my description of it and its adoption, for trial at least, by other orthodontists.

Its advantages over other forms of appliances in use are:

First. Much better occlusal results are obtained by it.

Second. The enlargement of the nasal passages is tremendously greater than by any method that tips the molars and bicuspids in expansion.

These two advantages overshadow any disadvantage it might develop.

Third. The patient can remain away from the operator much longer periods of time.

Fourth. It compels the use of the iridio-platinum arch, which is, in my mind, far superior to the German silver.

Fifth. The period of retention is much shortened. The appliance itself being the best possible retaining device.

Its one disadvantage is that it requires more skill, time and work to make and place the appliance properly.

EDITORIAL

Bills Affecting Dentists Enacted by the Last Congress.

The Congress which terminated on March 4th will be memorable in the annals of dentistry, because of two acts passed in the closing session. First, an act creating an officered Dental Corps for the Army, and second, an act authorizing twelve medical inspectors for the public schools of the District of Columbia, two inspectors to be dentists.

For years the dental profession has been anxious to see the Army dentists accorded rank, and the National Dental Association has maintained a committee annually to further such legislation, but without success. During the last days of the recent Congress, Senator Buckley, of Connecticut, saw an opportunity to further the cause which he has long favored. The bill appropriating funds for the support of the Army had passed the House of Representatives, and was under consideration in the Senate, when Senator Buckley moved an amendment creating an officered Dental Corps for the Army. This was accepted and passed by the Senate. This amendment in substance was the same as the bill of similar nature passed by the Senate during the previous Congress, and would have been most satisfactory to the Corps, and to the profession at large, but this bill did not have the indorsement of the War Department, without which

there was small chance of its passage, and therefore even the most ardent well-wishers of the men in the Contract Corps scarcely expected to see it finally enacted into a law. The Appropriation bills of the House and Senate differing in many respects, the usual course was pursued, and the whole question was referred to a Conference Committee of the House and Senate. On February 8 the Secretary of War addressed a communication to the Chairman of the Senate Committee on Military Affairs, recommending that the amendment adopted by the Senate be stricken out, and that if anything be substituted therefor, it should be what has been known as the Wiley bill (H. R. 23097, 61st Congress), with certain minor changes. This recommendation from the Secretary of War was adopted by the Conference Committee, with the result that when the Appropriation bill passed (Public—No. 453) it contained the following clause, which creates a new officered Army Dental Corps:

Army Dental Corps Bill as Passed.

"Hereafter there shall be attached to the Medical Department a dental corps, which shall be composed of dental surgeons and acting dental surgeons, the total number of which shall not exceed the proportion of one to each thousand of actual enlisted strength of the Army; the number of dental surgeons shall not exceed sixty, and the number of acting dental surgeons shall be such as may, from time to time, be authorized by law. All original appointments to the dental corps shall be as acting dental surgeons, who shall have the same official status, pay, and allowances as the contract dental surgeons now authorized by law. Acting dental surgeons who have served three years in a manner satisfactory to the Secretary of War shall be eligible for appointment as dental surgeons, and, after passing in a satisfactory manner an examination which may be prescribed by the Secretary of War, may be commissioned with the rank of first lieutenant in the dental corps to fill the vacancies existing therein. Officers of the dental corps shall have rank in such corps according to date of their commissions therein, and shall rank next below officers of the Medical Reserve Corps. Their right to command shall be limited to the dental corps. The pay and allowances of dental surgeons shall be those of first lieutenants, including the right to retirement on account of age or disability, as in the case of other officers: *Provided,* That the time served by dental surgeons as acting dental or contract dental surgeons shall be reckoned in computing the increased service pay of such as are commissioned under this Act. The appointees as acting dental surgeons must be citizens of the United States between twenty-one and twenty-seven years of age, grad-

uates of a standard dental college, of good moral character and good professional education, and they shall be required to pass the usual physical examination required for appointment in the Medical Corps, and a professional examination which shall include tests of skill in practical dentistry and of proficiency in the usual subjects of a standard dental college course: *Provided,* That the contract dental surgeons attached to the Medical Department at the time of the passage of this Act may be eligible for appointment as first lieutenants, dental corps, without limitation as to age: *And provided further,* That the professional examination for such appointment may be waived in the case of contract dental surgeons in the service at the time of the passage of this Act, whose efficiency reports and entrance examinations are satisfactory. The Secretary of War is authorized to appoint boards of three examiners to conduct the examinations herein prescribed, one of whom shall be a surgeon in the Army and two of whom shall be selected by the Secretary of War from the commissioned dental surgeons."

The Age Limit Bug-a-boo.

For years we have had it dinned into our ears by certain committeemen that Congress never would allow the Contract Army Dentists to enter an officered Corps without regard to age, and now we find that Congress has done exactly that. The language of the bill reads: "*Provided,* That the Contract Dental Surgeons attached to the Medical Department at the time of the passage of this Act may be eligible for appointment as first lieutenants, dental corps, without limitation as to age." In view of this action by Congress, it would seem that a great deal of explanation would be required to explain why a draft of a Dental Corps bill, assiduously advocated even during the very last days of Congress, should have contained an age limit clause which would have excluded the older men in the Contract Corps if it had been enacted into law.

Dental Inspectors for District of Columbia.

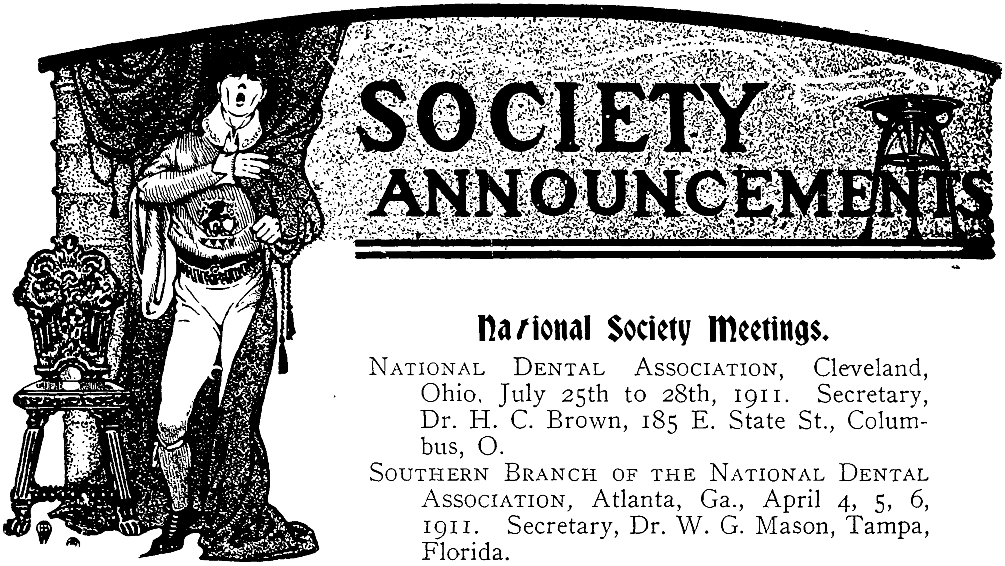
The Appropriation bill for the District of Columbia also contained a clause of dental interest, since it regularly authorizes the appointment of two dental inspectors for the public schools of the District of Columbia. The Law (Public—No. 441) reads as follows:

"Medical Inspectors—Twelve medical inspectors of public schools, two of whom shall be dentists, and four shall be of the colored race, at five hundred dollars each, six thousand dollars: *Provided,* That said inspectors shall be appointed by the commissioners only after competitive

examination, and shall have had at least five years' experience in the practice of medicine or dentistry in the District of Columbia, and shall perform their duties under the direction of the health officer, and according to rules formulated from time to time by him, which shall be subject to the approval of the Board of Education and the commissioners."

The above law was favored by the Monday Evening Club, a powerful social organization in Washington, and Dr. Emory A. Bryant was appointed Chairman of the club's Legislation Committee to further this enactment.

The Pen. Dr. Bryant at present is the proud possessor of the pen with which both of these important bills were signed by President Taft, and it is the same pen which he furnished to President Roosevelt and to Speaker Cannon when they signed the law allowing reciprocal exchange of dental licenses. Dr. Bryant has devoted a tremendous amount of time and energy in furthering legislation by Congress for the advantage of dentists and dentistry, and the profession owes him a debt of gratitude.



SOCIETY ANNOUNCEMENTS

National Society Meetings.

NATIONAL DENTAL ASSOCIATION, Cleveland, Ohio, July 25th to 28th, 1911. Secretary, Dr. H. C. Brown, 185 E. State St., Columbus, O.

SOUTHERN BRANCH OF THE NATIONAL DENTAL ASSOCIATION, Atlanta, Ga., April 4, 5, 6, 1911. Secretary, Dr. W. G. Mason, Tampa, Florida.

AMERICAN SOCIETY OF ORTHODONTISTS, September 20, 21, 22, 23, 1911, Boston, Mass.
Secretary, Dr. F. C. Kemple, 576 Fifth Avenue, New York.

State Society Meetings.

ALABAMA DENTAL ASSOCIATION, Montgomery, Ala., May 9, 1911.
Secretary, Dr. E. W. Patten, Selma, Ala.

ARKANSAS STATE DENTAL ASSOCIATION, Pine Bluff, Ark., about June 1st.
Secretary, Dr. I. M. Sternberg, Fort Smith, Ark.

CALIFORNIA STATE DENTAL ASSOCIATION.
Secretary, Dr. C. E. Post, 126 Stockton St., San Francisco, Cal.

COLORADO STATE DENTAL ASSOCIATION, Boulder, Colo., June 29, 30, July 1, 1911.
Secretary, Dr. Chas. A. Monroe, Willard Block, Boulder, Colo.

CONNECTICUT STATE DENTAL ASSOCIATION, Hartford, Conn., April 18, 19, 1911.
Sec'y, Dr. Robert H. W. Strang, Sanford Bldg., Bridgeport, Conn.

DELAWARE STATE DENTAL SOCIETY.
Secretary, Dr. Warren Combs, 410 Delaware Ave., Wilmington, Del.

FLORIDA STATE DENTAL SOCIETY, Pensacola, Fla., June 20, 1911.
Secretary, Dr. W. A. Dean, Tampa, Fla.

GEORGIA DENTAL SOCIETY, Macon, Ga., June 8, 1911.
Secretary, Dr. DeLos H. Hill, Grant Bldg., Atlanta, Ga.

ILLINOIS STATE DENTAL SOCIETY, Peoria, Ill., May 9, 10, 11, 12, 1911.
Secretary, Dr. J. F. F. Waltz, Decatur, Ill.

SOCIETY ANNOUNCEMENTS

INDIANA STATE DENTAL ASS'N, Indianapolis, Ind., May 16, 17, 18, 1911.
Secretary, Dr. Otto U. King, Huntington, Ind.

IOWA STATE DENTAL SOCIETY, Des Moines, May 2, 3, 4, 1911.
Secretary, Dr. W. G. Crandall, Spencer, Ia.

KENTUCKY STATE DENTAL ASSOCIATION, Owensboro, Ky., May 23, 24, 25, 1911.
Secretary, Dr. W. M. Randall, Louisville, Ky.

MAINE DENTAL SOCIETY, Fabyan, N. H., June 27, 28, 29, 30, 1911.
Secretary, Dr. I. E. Pendleton, Lewiston, Me.

MARYLAND STATE DENTAL ASSOCIATION.
Secretary, Dr. F. F. Drew, 701 N. Howard St., Baltimore, Md.

MASSACHUSETTS DENTAL SOCIETY.
Secretary, Dr. C. W. Rogers, 165 Howard St., Dorchester, Mass.

MICHIGAN STATE DENTAL SOCIETY.
Secretary, Dr. Marcus L. Ward, Detroit, Mich.

MINNESOTA STATE DENTAL ASSOCIATION, Minneapolis, Minn., June 9, 10, 1911.
Secretary, Dr. B. A. Sandy, Andrus Bldg., Minneapolis, Minn.

MISSISSIPPI DENTAL ASSOCIATION, Hattiesburg, Miss., May, 1911.
Secretary, Dr. L. B. Price, Corinth, Miss.

MISSOURI STATE DENTAL ASSOCIATION, Joplin, Mo., June 13, 14, 15, 1911.
Secretary, Dr. S. C. A. Rubey, Clinton, Mo.

MONTANA STATE DENTAL SOCIETY, Helena, Mont., June 2, 3, 1911.
Secretary, Dr. R. H. Severance, Great Falls, Mont.

NEBRASKA STATE DENTAL SOCIETY, Lincoln, Neb., May 16, 17, 18, 1911.
Secretary, Dr. J. H. Wallace, 212 Brown Block, Omaha, Neb.

NEW MEXICO DENTAL SOCIETY.
Secretary, Dr. L. E. Erwin, Carlsbad, New Mexico.

NEW HAMPSHIRE STATE DENTAL SOCIETY, Fabyan, N. H., June 27, 28, 29, 30, 1911.
Secretary, Dr. F. F. Fisher, 913 Elm St., Manchester, N. H.

NEW JERSEY STATE DENTAL SOCIETY, Asbury Park, N. J., July 19, 20, 21, 1911.
Secretary, Dr. Chas. A. Meeker, 29 Fulton St., Newark, N. J.

NEW YORK STATE DENTAL SOCIETY, Albany, N. Y., May 4, 5, 6, 1911.
Secretary, Dr. A. P. Burkhart, 52 Genesee St., Auburn, N. Y.

NORTH CAROLINA DENTAL SOCIETY, Morehead City, N. C.
President, Dr. A. H. Fleming, Louisburg, N. C.

NORTH DAKOTA STATE DENTAL SOCIETY, May 11, 1911.
Secretary, Dr. F. A. Bricker, Fargo, N. Dak.

OHIO STATE DENTAL SOCIETY.
Secretary, Dr. F. R. Chapman, Schultz Bldg., Columbus, Ohio.

OREGON STATE DENTAL ASSOCIATION.
Secretary, Dr. F. H. Walgamitt, Medical Bldg., Portland, Ore.

PENNSYLVANIA STATE DENTAL SOCIETY, Scranton, Pa., June 27, 28, 29, 1911.
Secretary, Dr. Luther M. Weaver, 7103 Woodland Ave., Philadelphia, Pa.

RHODE ISLAND DENTAL SOCIETY.
Secretary, Dr. C. A. Carr, 209 Spring St., Newport, R. I.

SOUTH CAROLINA DENTAL ASSOCIATION, Columbia, S. C.
Secretary, Dr. W. B. Simmons, Piedmont, S. C.

SOUTH DAKOTA STATE DENTAL SOCIETY, Aberdeen, S. D., May 16 and 17, 1911.
Secretary, Dr. M. R. Hopkins, Aberdeen, S. D.

TENNESSEE DENTAL ASSOCIATION, Nashville, Tenn., May 23, 24, 25, 1911.
Secretary, Dr. Walter G. Hutchinson, 151 8th Ave., North, Nashville, Tenn.

TEXAS STATE DENTAL ASS'N, San Antonio, Tex., May 11, 12, 13, 1911.
Secretary, Dr. J. G. Fife, 736 Wilson Blvd., Dallas, Tex.

UTAH STATE DENTAL SOCIETY.
Sec'y, Dr. W. G. Dalrymple, 2421 Washington Ave., Ogden, Utah

VERMONT STATE DENTAL SOCIETY, Fabyan, N. H., June 27, 28, 29, 30, 1911.
Secretary, Dr. H. F. Hamilton, Newport, Vt.

VIRGINIA STATE DENTAL ASSOCIATION, Richmond, Va., June 14, 15, 16, 1911.
Secretary, Dr. W. H. Pearson, Hampton, Va.

WASHINGTON STATE DENTAL SOCIETY, Tacoma, Wash., June 1, 2, 3, 1911.
Secretary, Dr. Burton E. Lemley, 930 C St., Tacoma, Wash.

WEST VIRGINIA STATE DENTAL SOCIETY.
Secretary, Dr. F. L. Wright, Wheeling, W. Va.

WISCONSIN STATE DENTAL SOCIETY, Eau Claire, Wis., July 11, 12, 13, 1911.
Secretary, Dr. O. G. Krause, Wells Bldg., Milwaukee, Wis.

National Dental Association Clinics.

The Clinic Program for the meeting at Cleveland promises to be an unusually interesting and profitable one. Every effort is being put forth to secure the very best talent as clinicians in the profession.

It is our intention to make this clinic the most interesting and profitable one in the history of the National Association. We have at this early date (March 1st) secured men of National reputation to clinic on the following subjects: Oral Surgery, Prophylaxis, Orthodontia; we hope to arrange a Concerted Gold Filling Clinic in Cavities in Pearl Matrices (by 10 operators), under direction of Dr. Southwell, of Milwaukee; Progressive Gold and Porcelain Clinics, Gold Inlays, and many other demonstrations. Canada and Europe will be represented, and we are making great efforts to have every State present its best clinicians. We solicit clinics from any member of a State or District Society, and a most cordial invitation is extended to our Canadian brethren.

Send in your names at once with title of clinic to any member of the committee, that we can have the program published in the journal's June issue. D. O. M. Le Cron, Chairman.

501 Missouri Trust Bldg., St. Louis, Mo.

Illinois State Board of Dental Examiners.

The semi-annual meeting of the Illinois State Board of Dental Examiners, for the examination of applicants for a license to practice dentistry in the State of Illinois, will be held at the Chicago College of Dental Surgery, corner Harrison and Wood Streets, Chicago, beginning Monday, June 5, 1911, at 9 A. M. "The following preliminary qualifications shall be required of candidates to entitle them to examination by this Board for a license to practice dentistry in the State of Illinois: Graduates of a reputable dental or medical school or college, or dental department of a reputable university, who enter the school or college as freshmen on or after the school year 1906-7, must have a minimum preliminary education of not less than graduation from an accredited high school or a certificate from the State Superintendent of Public Instruction, equivalent officer or deputy, acting within his proper or legal jurisdiction, showing that the applicant had an education equal to that obtained in an accredited high school; which certificate shall be accepted in lieu of a high school diploma." Candidates will be furnished with proper blanks and such other information as is necessary, on application to the secretary. All applications must be filed with the secretary five (5) days prior to date of examination. The examination fee is twenty dollars ($20), with an additional fee of five dollars ($5) for a license. Address all communications to T. A. Broadbent, Secretary.

705 Venetian Building.

Virginia State Dental Association.

The Virginia State Dental Association will hold its annual meeting at The Jefferson, Richmond, Va., June 14-15-16, 1911. There is a very attractive program being arranged, and all ethical dentists are invited to attend.

W. H. PEARSON, Secretary.

Hampton, Va.

New Jersey State Dental Society.

The forty-first annual meeting of the New Jersey State Dental Society will convene at Asbury Park, N. J., in the Casino on the 19th, 20th and 21st of July, 1911, beginning Wednesday at 10 A. M.

Extensive alterations will be made on the main floor, and the largest exhibit ever given by any State Society will be inaugurated, showing modern dental furniture and up-to-date instruments.

Application at an early date to the Chairman of the Exhibit Committee, Dr. W. W. Hawke, of Flemington, N. J., is necessary to secure space.

Papers and clinics by the most eminent men of the profession.

Watch the dental journals for further particulars.

CHARLES A. MEEKER, D.D.S., Secretary.

Missouri State Dental Association.

The forty-sixth annual meeting of the Missouri State Dental Association will be held in Joplin, June 13-14-15. An elaborate program is being prepared, and indications are that this will be the best meeting ever held by the Association.

For advertising space, program or other information, address Dr. J. A. Cotton, Chairman of the Executive Committee, Joplin, or Dr. S. C. A. Rubey, Secretary of the Missouri State Dental Association, Clinton.

Kentucky State Denta Association.

The forty-second annual meeting of the Kentucky State Dental Association will be held at Owensboro, May 25-26-27, 1911. This meeting is to be the last State Dental Society to hold its annual meeting, according to the circuit established between Iowa, Illinois, Indiana and Kentucky; hence, we expect to have an unusually large exhibit, as well as a good program. All members of the profession are cordially invited.

W. M. RANDALL, Secretary.

Cor. Brook and Broadway, Louisville, Ky.

Minnesota State Dental Association.

The twenty-eighth annual meeting of the Minnesota State Dental Association will convene in Masonic Temple, Minneapolis, June 9-10, 1911.

A number of clinicians in addition to home talent will be present, and a manufacturers' exhibit is also being arranged.

The profession is cordially invited. Address inquiries or suggestions to BENJAMIN SANDY, Secretary.

827 Andrus Bldg., Minneapolis, Minn.

South Carolina State Dental Society.

The forty-first annual convention of the South Carolina State Dental Association will be held in Columbia, S. C., June 20, 21 and 22, 1911.

W. BUSEY SIMMONS, Secretary.

Piedmont, S. C.

Texas State Dental Association.

The thirty-first annual meeting of the Texas State Dental Association will be held in San Antonio May 11, 12 and 13.

A cordial invitation is extended all ethical members of the profession.

J. G. FIFE, Secretary.

Dallas, Texas.

Oklahoma State Dental Association.

It seems to be the custom of program committees in making dental society announcements to say: "This will be the best meeting ever held by the society," but we can doubly assure you that such will be true of the next annual meeting of the Oklahoma State Dental Association at Enid, Okla., Thursday, Friday and Saturday, June 1, 2, 3.

The program is completed, and there will be something of interest to all kinds of dentists.

Men from four or five States will take part in the program, more than forty clinics, interesting papers and discussions on live subjects, and a good social time are assured.

The "live ones" will be there, and surely no dentist in this section of the country can afford to miss this meeting.

Enid, Okla.

C. R. LAWRENCE,
Chairman of Program Committee.

The Tennessee Dental Association.

The annual meeting of Tennessee Dental Association will be held in Nashville May 23, 24 and 25, following the State Dental Board meeting.

A cordial invitation is extended to all ethical members of the dental profession. WALTER G. HUTCHISON, Cor. Secretary.

Nashville, Tenn.

North Dakota Dental Association.

The sixth annual meeting of the North Dakota Dental Association will be held at Fargo, North Dakota, on May 16 and 17, 1911.

Fargo, N. D. F. A. BRICKER, Secretary.

Arizona Board of Examiners.

There will be a meeting of the Arizona Board of Dental Examiners on the 24th to 29th of April at Phoenix, Arizona.

Candidates should present their application, and fee of $25 should accompany same, at least twenty days before meeting.

Theoretical examination includes the following subjects: Anatomy, Physiology, Chemistry, Materia Medica, Therapeutics, Metallurgy, Histology, Pathology, Oral Surgery, Operative and Mechanical Dentistry. Practical demonstration of skill in operative and mechanical dentistry will also be required, and candidates should come prepared with instruments and material for making fillings and crowns in the mouth.

W. A. BAKER, D.D.S., Secretary and Treasurer.

Tucson, Arizona.

Fifth District Dental Society of the State of New York.

The annual meeting of the Fifth District Society will be held at the Onondaga Hotel, Syracuse, N. Y., April 13, 14 and 15. A cordial invitation is extended to all ethical members of the profession.

J. N. GARLINGHOUSE, Secretary.

Clinton, N. Y.

Maryland State Board of Dental Examiners.

The Maryland State Board of Dental Examiners will meet for examination of candidates for certificates May 24 and 25, 1911, at the Baltimore College of Dental Surgery, Baltimore, at 9 A. M.

For application blanks and further information address

F. F. DREW, D.D.S., Secretary.

701 N. Howard St., Baltimore, Md.